THE MARINE REVIEW

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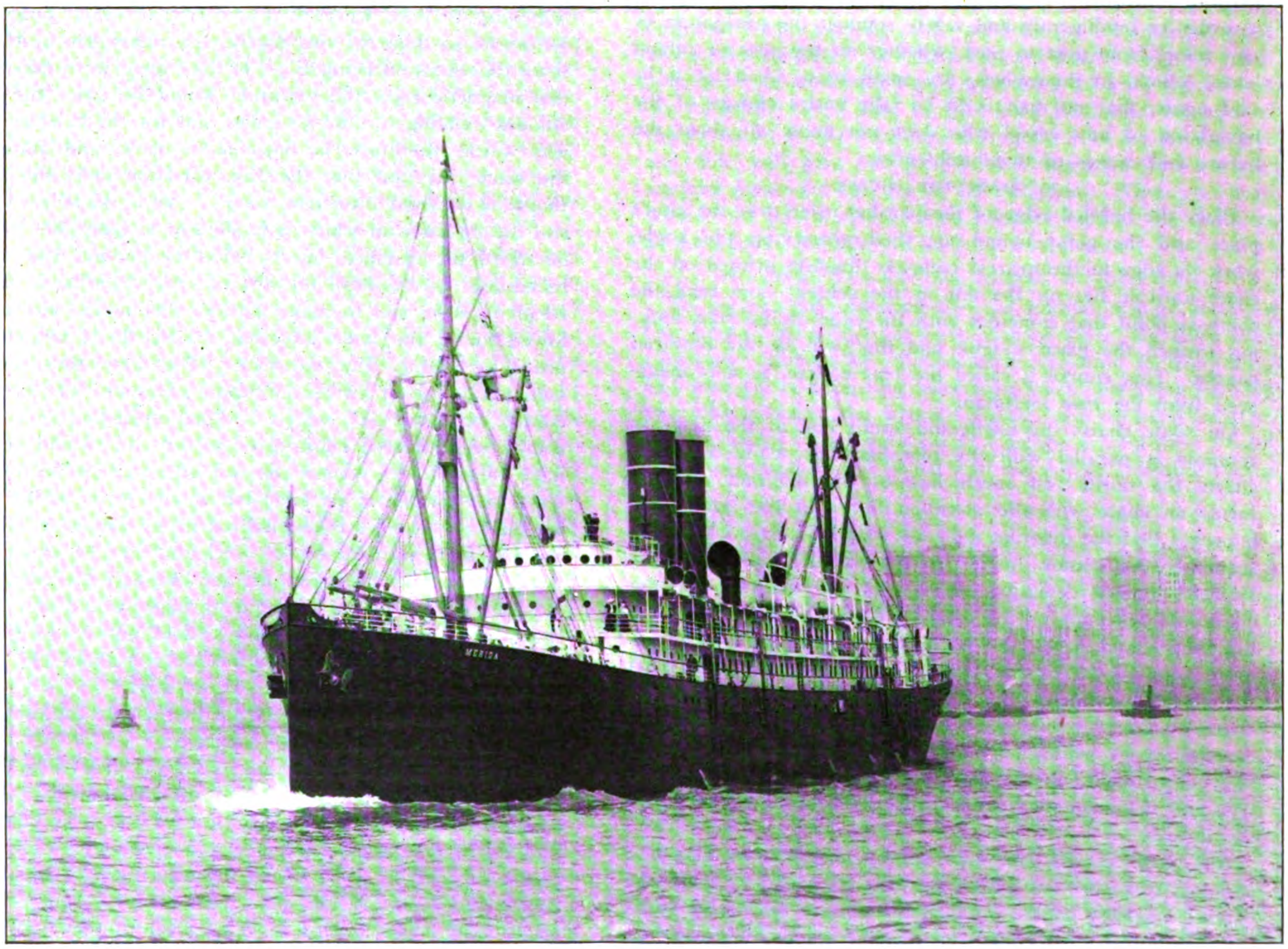
WARD LINER MERIDA.

The new passenger and freight steamer Merida recently delivered by Cramps, Philadelphia, to her owners, the Ward Line of New York, is one of the handsomest vessels in the coastwise service, as the accompanying beautiful photograph will very clearly show. She is the embodiment of the latest in steamship practice and is equal in every respect to the finest of liners. The Merida is built of steel throughout, including deck houses, pilot houses and spars. This steamship is 416 ft. over all, 400 ft. between perpendiculars, 50 ft. beam and 38 ft. deep. Her twin screws are driven by two engines of the triple-expansion, surface-condensing type, with cylinders 28, 46 and 76 in. diameters by 42 in. stroke, supplied with steam from four cylindrical boilers, two of the double-ended and two of the single-ended type, the former being 18½ ft. by 15½ ft. and the latter 10½ ft. by 15 ft. 3½ in. The Merida has 90 staterooms with accommodations for 187 first cabin, forty-eight second cabin and twenty-four deck passengers. Her steering gear was supplied by Williamson Bros., of Philadelphia, her life rafts by David Kahnweiler's Sons, New York, her metal life boats by the New York Ship Building Co., Camden, N. J., and her windlasses by the Hyde Windlass Co., Bath, Me. Her rubber tiling is of the interlocking type and her pumps are of Blake manufacture. A refined elegance characterizes her interior appointments, the decorative effect being unobtrusive and in extremely good taste. Every accommodation possible is provided for the passengers and the Merida is certainly a triumph.



THE NEW COASTWISE STEAMER MERIDA.

SHAPING THE COURSE.

By Clarence E. Long.

By means of the chart and parallel ruler, or other instrument, for taking off the course, or where courses are printed on charts, as on the lake survey charts, the navigator is able to find his way from port to port.

From the chart he lays off, or notes the course, he desires to steer. This is the *true* course, and to this true course he applies the mean or average variation between departure and destination (if the course is not too long), and this gives the *correct magnetic* course; that is, the true course corrected for variation. To this correct magnetic course he applies the deviation corresponding thereto, which is taken from the deviation table or curve, for that particular compass. This, then, is the *compass* course; that is, the correct magnetic course corrected for deviation, or it is the course to be steered by compass, and although it may differ considerably from the true course started with, it is in reality the true course first sought; the ship's head is made to point out the true direction started with, but it is due to the correction of variation and deviation that makes it appear otherwise by compass.

We will now proceed to show the manner in which these various influences should be dealt with in every-day practice, in order to intelligently and safely conduct the navigation of any vessel from port to port, whether on the seas or inland lakes, which, in themselves, are small seas. And let it be said again, that no man is fit to take entire charge of the navigation of any vessel who does not know all about the nature and causes of these influences.

TO SHAPE THE COURSE.

Place the beveled edge of the parallel ruler over the ship's place and the point bound to; then preserving the angle, work its edge to the nearest compass diagram printed on the chart until it lies on the dot in the center; now read the compass point that coincides with the edge of the rule, looking toward the place sought, and that will be the required course. This course is called the *true* course, as it is measured from the *true* meridian.

On some charts the north and south line of the diagram compass is parallel with the meridian line while on other charts the north and south line of the diagram compass forms an angle with the meridian line. In the latter case it proves that the diagram indicates magnetic directions; consequently the course found by the parallel rulers will be steered (unless deviation exists) as the diagram on the chart is a reflection of the compass on board the vessel. On the other hand, when the north and south line of the diagram compass is parallel with the meridian, it proves that the diagram indicates true or geographical directions. Lake charts on the polyconic projection (Engineers') have the true compass roses printed thereon, and those published by the navy department, on the mercator projection, have both the true and the magnetic compass roses, the latter being within the former.

And now all the late lake survey charts have magnetic compass roses printed within the true rose, and by them the correct magnetic course is taken off at once by merely reading the angle the parallel ruler makes with the magnetic rose. The true course can likewise be seen at the same time by reading on the outer row of subdivisions, which are true directions.

As we have already pointed out, there is liability of error creeping into the course from the practice of such a method; and the error in question is of the snake-in-the-grass type, and, therefore, hard to locate at the end of the course by reason of its insuspectibility. The navigator would be more apt to lay the blame to a wrong than a right cause. The explanation is this: The variation at one end of a route does not agree with the variation at the other end, as the magnetic compass roses and the explanation of its use would indicate. True, they will work out correctly in many places, but there are many more cases where the error therefrom is large enough to materially affect the course. When the magnetic compass rose lies about midway between the ends of the route projected, or to be projected, then the rose so printed represents the mean or average variation between the ends of the route, or the angle of the mean variation is preserved throughout the length of the course; for if the variation at departure and that at destination be added together and the mean taken, it would be found to compare favorably with the amount of the variation that the magnetic rose is slewed from the true meridian. In this case the course read from the rose gives the correct magnetic course at once.

Take the course from Whitefish Pt. to Keweenaw Pt., Lake Superior (crossing the line of no variation). Were the navigator to take his course from the magnetic rose nearest his departure (the instructions given on some charts) he would have westerly variation allowed to his course from beginning to end, whereas this variation would only agree for about 50 miles of the course, the remainder of the distance the variation being Ely. If the course were taken from this magnetic rose, the variation would be twice the actual amount existing for the 50 miles, and for the balance of the way would, therefore, be opposite in name, and allowed in the same direction that the Ely. variation pulls the needle, that is, to the right of the true course. Thus, the Wly. variation and the direction in which it is allowed is applicable to about one-third the distance, but is twice its amount, and for the remaining two-thirds of the distance the variation is Ely. instead of Wly., and to make matters that much worse, is allowed for in the same way that the needle is influenced in order to produce Ely. variation. The error thus produced amounts to about twice the mean variation for the entire course, or about 44°, which is equal to saying that if this course were steered right through the ship would be some nine miles off the course she was supposed to be following when she arrived at its end; but as the error in the course for the first 50 miles is one-half of the variation at Whitefish Pt. and from the line of "no variation" to the Point is the whole amount at Whitefish Pt. and one-half the variation at Keweenaw Pt., the error right through would not be the same, consequently the distance would not be so great as given above. In other words, the error is about 1¼° for 50 miles and about 3° the balance of the way.

This worked out in an example just as the conditions prevail will make it more comprehensive:

The true course between those points is WNW ⅛ W, Var. at Whitefish Pt. 2½° Wly. (the amount that the magnetic compass rose is slewed to the left of the true points) so that this course taken from it would give a correct magnetic course of NW by W ⅞ W, all the way through, whereas the course should be WNW (the mean of 2½° being equal to about ⅛ pt., and as this is Wly. allow to the right of the true course WNW ⅛ W) to the line of no variation. From the line of no variation to Keweenaw Pt. the variation increases to 2¼° Ely., at the latter place. The mean of this is equal to nearly ⅛ pt., and this allowed to the left of the given true course (WNW ⅛ W) is WNW ¼ W, or ⅜ pt. difference between the two courses.

We see from this that it is important and absolutely necessary to take into consideration the variation at both ends of

the route, and that the variation at departure will not agree all along any one route; nor will the variation at destination agree with the variation at departure. The only correct and safe way this can be done, and should be done, is to take the mean of the variations at departure and destination, and apply the amount to the true course to get the correct magnetic course.

While the foregoing example may be an extraordinary one, it goes to show that the method of taking off the correct magnetic course from the magnetic rose is not only incorrect, but a dangerous one, and one that may lead to disastrous results if practiced. As it is absolutely necessary to get the mean of the variations at each end of the route to work correctly, the question naturally suggests itself, of what use and good are these magnetic roses on the chart? Their accuracy, as we have seen, is more apparent than real, and therefore should be shunned by the navigator. No careful man would take the chance of its giving accurately the correct magnetic course, unless he first compared and proved it; and as it becomes necessary to do this each time, the magnetic roses render no service whatever in arriving at the truth of the matter and, therefore, should be dispensed with. They are more harmful than good; they look nice and that is all.

MAGNETIC VARIATION.

It is very important that the navigator should have a thorough knowledge of the magnetic variation. The amount of allowance and its direction, and annual change are indicated on the charts. On all mercator charts, with the exception of harbor charts, will be found irregular lines running from the top to bottom of the paper in a northwesterly and southeasterly direction, and having beside them such inscriptions as 5° Wly., 8° Ely. This means that along this line the variation of the compass from true north is W. 5°, 8° E. There are certain lines, which have no variation, and here no allowance is to be made. There is one such line in the region of the great lakes. It passes through the east end of Lake Superior, thence across the Straits of Mackinac down through central Michigan. This line is called the "line of no variation." At all places to the east of this line of no variation the variation is westerly, and at all places to the west it is easterly. Westerly variation is increasing and easterly variation is decreasing, or in other words, the line of no variation is moving west. On harbor charts the variation is shown by the compass card printed on the chart. The north point of it will be found slewed a little to the eastward or westward of a meridian line. On all mercator charts, inside of each compass rose will be found an inscription such as "Var. 8° Ely. in 1898; decreasing 5′ annually." On the charts published by the Engineers' Dept., you will find a table of magnetic variation or declination, giving the variation for the different localities with the annual increase and decrease.

The latest lake survey charts now contain, not only the magnetic compass diagrams or roses, but tables of the magnetic variation, and in many places the magnetic meridian is shown by a line about three inches long drawn to show the angle of the variation, or, in other words, the magnetic needle uninfluenced at that place. The variation tables are corrected for the year of publication of the chart, and are of great benefit to the navigator if he understands how to apply them.

ANNUAL CHANGE IN THE VARIATION.

A knowledge of this is very important, as in many parts of the world it is very rapid, and after a few years the correction becomes quite a consideration. Masters are not always acquainted with this peculiarity of terrestrial magnetism, and, in consequence, give courses which were the correct thing years ago, but are so no longer. It is evident, from what has just been stated, that correct magnetic courses given in sailing directions need revision in a comparatively short time. A man with a chart, and possessed of the above knowledge, does not require such dry nursing.

TO ALLOW FOR VARIATION BETWEEN DEPARTURE AND DESTINATION.

To apply the variation to a true course, to obtain a correct magnetic course, between a point of departure and a point of destination add the two variations together if they have like names, that is, both easterly or both westerly, and take the mean of the sum by dividing by 2. The quotient will be the proportional variation to be applied to the true course between the two points. For example:

Variation at Chicago	2° 49′ Ely.
Variation at Twin River Pt.	2° 15′ Ely.
2)	5° 04′
Variation to be applied	2° 32′ Ely.

The above method of applying the variation may be used where there is ample room, but on long routes, where the variation changes rapidly, to apply a single correct magnetic course to be steered all along the line, might lead to dangerous results. Long, straight routes should be subdivided into parts and the correct magnetic course given for each part.

However, on most lake routes it is practicable to take the mean of the two variations. Remarks:—If the variation at departure was easterly and westerly at destination what would that indicate? It would indicate that in order to reach your point of destination you will have to cross the line of no variation. In a case of this kind just take one-half of the variation at the departure and apply it to the true course and this will give the proportional variation between the starting point and the line of no variation. When you have crossed the line of no variation take one-half of the variation at destination and apply it to your true course.

TO CORRECT FOR ANNUAL CHANGE IN VARIATION.

To correct the variation for the annual change multiply the number of years that have elapsed since the chart was corrected. Remember, that easterly variation is decreasing and westerly is increasing; therefore, when correcting easterly variation subtract the annual change, and westerly add it. For example: The variation at Chicago in 1898 was 2° 49′ E, annual change 4.7′. What will the correct variation be in 1906?

Variation at Chicago 1898 ...... 2°	58.4′ Ely.
Decreasing annually, 4.7′, 8 years	38.4′ (subtract).
Correct variation at Chicago, 1906 2°	20.0′ Ely.

Example:—If the annual change in the variation is 5′, how many years will it take to effect the variation 1°? Ans. 12 years, because in 1° there are 60′, and 5′ is contained in 60′ 12 times, or 12 years.

OPPOSITE AND REVERSE.

Do not get the terms "opposite" and "reverse," as applied to the compass mixed up with each other. Mariners, generally, are a trifle out of their latitude on this seemingly "knotty" subject; but there is no reason for confusion as there is a marked distinction between the two terms. The average person will use reverse and opposite as meaning one and the same thing in speaking of the directions on the compass, or horizon; as for instance, they will tell you that SE is opposite NW, but this is not so, the opposite of SE is SW and NW is the reverse of SE.

Example:—Supposing the true or chart course (the course found by a true compass) is north, and the chart tells us, where the ship is situated, there is one point of westerly variation, which means that the north end of the compass needle is inclined one point to the west of the true or geographical north. Under these circumstances it will be necessary to steer N by E by the ship's compass in order to make a true

north course. If the variation happened to be easterly in the above case the vessel would have to steer N by W to make true north.

To Allow for Deviation:—The rule for applying deviation is exactly on the same principle as explained for variation. Easterly deviation to the *left* and westerly to the *right.* The deviation should be applied to the *correct magnetic* course, which gives the *compass* course. The deviation to be applied should be that which corresponds to the correct magnetic course and not the true course. Note:—Always apply the variation before applying the deviation.

Example:—Supposing the correct magnetic course is east, and there is one point of westerly deviation to be allowed when the ship's head is on that course; consequently, the compass course to be steered is E by S in order to make a correct magnetic east course.

Remember this. Applying the variation to a true course gives a correct magnetic course and the deviation applied to a correct magnetic course gives a compass course (applying the deviation to a true course will not give a compass course; it would be nameless, unless there happened to be no variation, then the true course would also be the correct magnetic course, and vice versa).

The difference between a true course and a correct magnetic course is the variation, and the difference between a correct magnetic course and a compass course is the deviation.

RIGHT AND LEFT ON THE COMPASS.

Right and *easterly* are one and the same thing when applied to the compass. Right means in the direction that the hands of a watch revolve; or in the direction of the apparent motion of the sun around the earth; that is, across the sky from east to west, or left to right. To move to the right around the compass from north, you would have to go by way of east, thence to south, and from south to west, and from west back to north.

Left and *westerly* are just opposite to the above. Left would be against the direction the hands of a watch revolve. Starting from north in the direction of left you would have to go to west, then south, east, and back to north.

Remember, that when you come to correcting bearings taken by your compass, which is affected by both variation and deviation, you will have to allow easterly variation and deviation to the right and westerly to the left, in order to convert a compass bearing to a true bearing to make it correspond with the chart.

Remarks:—When the variation and deviation are of the same name, both east or both west, they may be added together and applied. If the variation and deviation are of contrary names, they may be subtracted one from the other, and the balance applied in the name of the greater of the two quantities.

In neglecting small fractions in the variation and the deviation, be sure they are neglected on the safe side, for it can and will influence the course much more, probably, than you would think. For example: Supposing the mean variation on a 200-mile course is 3° 29′; now the question is, will you call this ¼-pt. or ⅜-pt.; it is as near to one as it is to the other, and under ordinary conditions would make no difference what you called it, but supposing you were steering a northerly course and your point of destination was on your starboard bow and you called the variation ⅜-pt. At the end of the course you would be nearly three miles inside of your course. In case the variation was reckoned as a quarter point you would be the same distance off the course, but on the deep water side of it. In cases of this kind it is best to steer on one side of the course for half the distance and on the other side the other half the run. Thus, in the above case the variation should be reckoned as ¼-pt. for half the distance, and ⅜-pt. the remainder of the distance. Where the course comes to eighths, and the compass card is graduated only to quarters, steer on the quarter-point for half the distance and the half-point the other half. The course is E ⅜ N. distance 90 miles: steer E ¼ N for 45 miles, and E ½ N 45 miles. Good steering boats should have large steering compasses graduated to degree divisions, and the course should be set to degrees.

Errors may even arise from neglecting small fractions in converting degrees into points, and influence the reckoning. For instance, the corrections being:

Variation	2 degrees	= ⅛ points
Deviation	3 degrees	= ¼ points
Leeway	6 degrees	= ½ points
Current	13 degrees	= 1⅛ pts.
Sum total	24 degrees	2 points.

As 24° equal 2⅛ points, there is a difference of ⅛ point in the total; and such small error in course may cause disaster.

The course to be made good depends on five different elements, namely: Variation, deviation, leeway, current and the true course as measured from the chart with the rulers. All these elements are liable to unavoidable errors, unless the greatest amount of care and precaution are taken by the navigator to avoid them. To show how easily a vessel may be led astray, supposing that each of the five elements differ only ½ degree from its correct value, and all errors have the same sign, the error in the course steered will be 2½°, or nearly ¼ point, which is equivalent to a sideway error in position of 1-20 the distance run, and on a run of 100 miles will amount to five miles to the right or left of the intended course.

This is a serious consideration in thick weather, and such errors can only be guarded against by the judicious use of the lead, the study of which is frequently neglected. Current is probably one of the most serious difficulties that the lake navigator has to contend with, on account of its varying quantity and no means of ascertaining its set and drift. All the other elements entering the course are controlled by the navigator, but as the current depends upon the wind and weather, its direction and speed cannot be depended upon for any length of time. The variation is obtained from the chart; leeway is easily determined during the voyage; the deviation may be ascertained before leaving port and during the voyage, but the corrections for current can only be ascertained during the voyage. As vessels are not provided with the necessary instruments for determining current, it is neglected, and therefore the current, when any exists, is bound to influence the course and in thick weather to lead the vessel to danger. In thick weather the navigator has to depend on the compass and log for his reckoning, known as "dead reckoning,"—a very good and appropriate name, for when the corrections for current are wanting, it is "dead," and completely so. The patent log cannot be depended upon to give the distance that the vessel has made good over the bottom, for the reason that the vessel and log both partake of the motion of the current; the log gives accurately enough the distance the vessel has made through the water, but not over the surface of the earth, hence it cannot be depended upon in thick weather.

On the ocean, with plenty of sea room left, an error in the reckoning from this cause is of little consequence, because of being rectified by subsequent astronomical observations; and when near the land in clear weather, by bearings. But in thick weather there is no chance for verifying position, neither by bearings nor by astronomical observations, and vessels have, therefore, to depend upon the reckoning by compass and log; and in the vicinity of land, if this reckoning is not correct, disaster generally follows. On account of the ease with which in clear weather errors in the reckon-

ing are rectified, vessels have become oblivious of the means for correcting position in thick weather and of ascertaining set and drift of current independently of the methods used in clear weather. Negligence in this respect has gone so far that, in fact, no facilities for determining the corrections for current are found aboard of any vessel, and the lack of such facilities is, in a large measure, the cause of errors in courses and distances.

To remedy this evil it has been suggested that vessels be equipped with the "ground log." The ground log consists of a heavy weight attached to a line divided into a forerunner of from 50 to 80 fathoms, and a sufficient number of knots of 25 ft. length. After the weight is lowered to the bottom and the forerunner is out, the counting commences, and the knots running out in 15 seconds give the rate of speed that the vessel is actually making over the ground in nautical miles per hour, which requires a small tabular correction for depth of water. The direction of the ground log line indicates the ship's course over the ground, and the angle which the line makes with the ship's keel, applied to the correct magnetic course the vessel is heading on, furnishes the true course made good. While the ground log is correct in principle and is not influenced by currents, it cannot be relied upon at all times and under all circumstances. It is evident that, to get the correct direction of the current, the ship must make a mathemetically straight wake during the operation, and her speed must be slow. In stormy weather the ground log could not be used to advantage, on account of the "send of the sea" and drift to leeward; hence, the whole operation would be little better than a good guess.

The lead plays the prominent part in coasting and the verifying of position in thick weather, but its judicious use is very little known. From time immemorial the lead has been justly looked upon as one of the mainstays of navigation, but it is not the indiscriminate casting of the lead on any course run, the practice in general use, which insures safety and prevents deception, but the shaping of courses and taking of soundings with regard to leading features of the ground, easily picked up and followed by compass and lead.

The bottom of the lake is most conveniently represented in charts, or should be represented, (the Hydrographic office charts are) by curves at different distances from the surface of the water, which curves are to be used in thick weather as general safeguards against stranding. They are guides, just as much as other aids to navigation, if known how to be used, and by their means the ship's place is found in thick weather. A continuous curve of equal depth, including all dangers to navigation along a certain part of the coast, and passing the danger nearest to the curve at a safe distance, is called a safety curve. For, by keeping the vessel in no less water than the depth of the safety curves indicates, stranding is prevented. Thus, the safety curve is a sure indicator of the boundary up to which a vessel may safely proceed. Furthermore, the safety curve, or any other curve of greater depth, may be used as a guide, especially in thick weather, and it is the straight parts of such curves which furnish reliable lines of position under all circumstances. Such a line followed up by compass and lead and continued over its tangent point will cut some other curve of different depth, the point of intersection invariably furnishing the true place the ship is in.

The study of problems of this description, on the correct solution of which frequently the safety of a vessel in thick weather depends, is thoroughly neglected.

As a single cast of the lead is worse than useless, inasmuch as it may confirm an error in the assumed position of the ship, the necessity for repeated soundings must be apparent, and these repeated soundings must be made without stopping the ship or deviating from the course. This is only supplied by the patent sounding machine, many varieties of which are now on the market. Over long routes out of sight of land, or in thick weather, the navigational sounding apparatus, for use with pianoforte wire, would be invaluable for determining positions, or at least for indicating the set and drift of the vessel. With this apparatus, Atlantic liners get soundings in depths as great as 100 fathoms (600 feet) without stopping the engines. The apparatus, briefly described, consists of a drum, about a foot in diameter and four inches wide, upon which 300 fathoms of steel pianoforte wire are tightly wound. To the wire is attached nine feet of log-line, and to this is fastened an iron sinker, about twice the length of the ordinary lead, but not so thick. On the log line, between the wire and the sinker, a small copper tube is securely seized. The lower end of this tube is perforated; the upper end being opened or shut at pleasure by means of a close-fitting clap. When ready for sounding, the copper tube contains a smaller sized glass one. This latter is also opened at the bottom end, and hermetically sealed at the other. The drum is fitted with a brake, which, on a cast being taken, controls its speed, and ultimately arrests it when the lead touches the bottom. A pair of small winch handles winds up the wire again, and the depth is shown by the height of the discoloration on the inside of the glass tube.

(*To be continued.*)

LIVERPOOL SHIPPING LETTER.

Liverpool, May 7.—The casualties to vessels of 500 tons gross register and upwards which have been posted in the Liverpool Underwriters' Association loss book during the month of April, include the following total loss: British sail 3, tonnage 5,950; British steam 3, tonnage 7,692; foreign sail 4, tonnage 4,270; foreign steam 6, tonnage 12,185. The totals of these figures were 16 vessels and 30,097 tons, as against 14 vessels and 19,056 tons for the corresponding month of last year. During the month the aggregate partial and total losses were 345, as against 362 for the corresponding month of 1905, 327 for April, 1904, and 380 for April, 1903. The nature of casuality is returned as follows: Collisions, 118; strandings, 107; damage to machinery, shafts and propellers, 46; fires and explosions, 22; founderings and abandonments, 3; missing, 1; weather damage, 38, and other casualties, 10.

The gross tonnage of the ships which passed through the Suez canal in the first quarter of the year was 4,934,345 tons, against 5,139,424 tons in 1905, and 4,648,529 tons in 1904. The net tonnage in the three years respectively was 3,527,243; 3,701,145; and 3,306,539; the number of small craft was 298 in 1906, 674 in 1905, and 801 in 1904, their tonnage in the three years being 5,287, 8,227, and 9,936 respectively. The tonnage dues received were 27,160,623 f. in 1906, 30,923,219 f. in 1905, and 28,055,546 f. in 1904. The passenger receipts in the three years amounted to 979,290 f., 668,083 f. and 70,012 f., respectively.

The fact that the order placed by the Allan line for a new steamer of over 10,000 tons, to be fitted with reciprocating engines, and not turbines, has occasioned much comment in British shipping circles during the past week. Everyone seems to have jumped to the conclusion that Messrs. Allan Bros. & Co. are not satisfied with the performances of their turbine steamers, Victorian and Virginian, but this assumption is quite unjustifiable and the Allan line are most anxious that this should be widely known. The new ship ordered, it appears, is intended to take the place of the Bavarian, whose services were lost to the company last year by stranding in the River St. Lawrence. The new boat is only meant to steam 16 knots, and it would be an obviously mistaken policy to equip such a vessel with turbines whose chief value lies in their adoption in passenger liners to run at high sea speeds. The company, it is important to add, express the utmost satisfaction with the Virginian and the

Victorian, and it is expected that they will at no distant date demonstrate further their faith in the turbine by issuing the specifications for the two coming vessels, larger and faster than the Virginian and Victorian, and similarly propelled. As is well known the turbine is at a great disadvantage at low speeds, hence reciprocating engines were intended for the new vessel from the first, the question of turbines never once arising.

The question of the extent to which marine underwriters are involved in the San Francisco disaster interests many in Britain, but there has been great difficulty in arriving at an estimate, and it is believed that the losses are not nearly so heavy as was at first anticipated. The Pacific Mail Company's two steamers, Mexican and Columbian, which suffered by the earthquake shock were covered for $600,000, and it is believed that the loss will not exceed from 15 to 20 per cent of the policy value. Another claim, it is said, will arise in the case of the ferry steamer Columbia, which was in dry dock at Oakland and capsized. Liverpool and London underwriters are interested in the above insurances, and M. S. Cross, underwriter of the Thames & Mersey Co., has proceeded to San Francisco on behalf of his own and other Liverpool companies and Lloyds underwriters.

The British solicitor general (Sir William Robson), is of opinion that any agreement on international maritime law will carry with it far-reaching and beneficial results. It was, he said, sought to lay down a code of international maritime law which should meet with the respect and approval of all maritime nations, and English lawyers just now were working out a great event which he believed would fill an important place in the history of the world so far as arbitration and federation was concerned.

The sale of British battleships, cruisers, gunboats and other fighting craft at Devonport dock yard on May 15, is quite an event in the ship auction trade, and the fact that the vessels in question are to be sold with no obligation as to breaking up, will provide an opportunity to some of the smaller states of the world to acquire a ready made navy on very short notice. Progress in warship construction proceeds at so rapid a speed nowadays that vessels become quite out of date for a first class power long before they cease to be really useful fighting ships, and it may be well worth the attention of various foreign representatives in Britain to examine the big batch for sale at Devonport in the hope of picking up a really cheap and effective lot.

The Cunard liner Lucania, which left Liverpool on Saturday afternoon for New York, included in her freight gold in bar and coin to the value of $2,500,000, weighing about five tons. On the previous Saturday, the Etruria from Liverpool to New York, carried $3,500,000 worth of gold bar and coin (seven tons), and the Campania from Liverpool to New York a week further back still took out no less an amount in value, $6,250,000, weighing between eleven and twelve tons. Hence it will be seen that in these three voyages the Cunard company's steamers have carried gold to the very respectable total in weight of nearly 24 tons, and in value $12,250,000—a fact which shows the confidence entertained in the Cunard line as a medium of transit.

Readers of the MARINE REVIEW will doubtless be interested in the official statement of what the British Cotton Growing Association is doing to develop cotton growing in British colonies. It is believed that the multiplication of the sources of cotton supply will not fail in the course of time, by averaging climatic risks and consequently preventing usual shortages, to exercise a steadying influence on cotton prices, with a resulting restraint on cotton gambling. Replying to a question put to him in the house of commons, the assistant secretary for the colonies said the amount of cotton grown under the auspices of the British Cotton Growing Association was in 1903 1,900 bales, valued at $145,000; in 1904, 6,000 bales, valued at $400,000; in 1905, 14,200 bales, valued at $950,000, and the estimate for 1906 was 20,000 bales, valued at $1,650,000. The government was in cordial co-operation with the association in the furtherance of its work.

After a detention of over a week the Dewey dock has now passed through the Suez canal, and has arrived at Suez, says the *Shipping Gazette*, London. The passage seems to have been void of untoward incident; so, by slow degrees, the ponderous structure is working her way out to the Philippines. The towage of the Dewey is undoubtedly unique in maritime history, both by reason of the long leagues of ocean to be traversed, and the weight of the towed structure. The Dewey is understood to weigh somewhere about 10,000 tons, and her form does not make her at all a "handy" tow. The construction and dispatching of this mammoth naval dry dock to the Philippines is, of course, entirely an American venture, but the three steamers engaged in the towing, the Glacier, Caesar, and Brutus, although they are now United States naval vessels, were all built in Britain. The Glacier, formerly the British steamer Port Chalmers, was built at Sunderland in 1891; the Caesar, launched at Stockton-on-Tees in 1896, was at one time the British steamer Kingtor; whilst the Brutus, formerly the Norwegian steamer Peter Jebsen, was put into the water at South Shields in 1894, and the massive hawsers used in towing were, so says the same authority, manufactured in Britain.

SUMMARY OF NAVAL CONSTRUCTION.

Following is the summary of progress on naval vessels, as compiled by the bureau of construction and repair:

Name of vessel	Building at	1906 Per cent of completion April 2.	May 1.
	BATTLESHIPS.		
Virginia	Newport News S. B. Co.	99½	99.9
Nebraska	Moran Bros. Co.	92	92.65
Georgia	Bath Iron Works	95.75	96.58
New Jersey	Fore River S. B. Co.	98.5	99.5
Connecticut	Navy Yard, New York	97.11	97.41
Louisiana	Newport News S. B. Co.	97.92	98.98
Vermont	Fore River S. B. Co.	79.3	83.8
Kansas	New York S. B. Co.	75.7	78.5
Minnesota	Newport News S. B. Co.	85.27	88.28
Mississippi	Wm. Cramp & Sons	52.84	54.88
Idaho	Wm. Cramp & Sons	51.44	53.52
New Hampshire	New York S. B. Co.	40.4	42.5
	ARMORED CRUISERS.		
California	Union Iron Works	91.9	92.8
South Dakota	Union Iron Works	89.8	90.4
Tennessee	Wm. Cramp & Sons	96.37	97.51
Washington	New York S. B. Co.	96.	97.3
North Carolina	Newport News S. B. Co.	39.97	42.73
Montana	Newport News S. B. Co.	35.40	38.24
	PROTECTED CRUISERS.		
St. Louis	Neafie & Levy S. & E. B. Co.	93.37	95.66
Milwaukee	Union Iron Works	92.5	94.3
	TRAINING SHIPS.		
Cumberland	Navy Yard, Boston	95.	95.
Intrepid	Navy Yard, Mare Island	97.5	97.5
	SCOUT CRUISERS.		
Chester	Bath Iron Works	26.15	29.44
Birmingham	Fore River S. B. Co.	28.6	31.3
Salem	Fore River S. B. Co.	28.9	32.2
	SUBMARINE TORPEDO BOATS.		
Submarine T. B. No. 9	Fore River S. B. Co.	63.9	68.2
Submarine T. B. No. 10	Fore River S. B. Co.	52.5	53.5
Submarine T. B. No. 11	Fore River S. B. Co.	58.2	60.5
Submarine T. B. No. 12	Fore River S. B. Co.	51.4	53.8

The Detroit Steel Castings Co., of Detroit, Mich., has just placed contract for a large addition to present plant, 125 x 180 ft. Two basic furnaces are to be added, which will double its present capacity. This company will make a specialty of large marine castings.

THE MARINE REVIEW

DEVOTED TO EVERYTHING AND EVERY INTEREST CONNECTED OR ASSOCIATED WITH MARINE MATTERS ON THE FACE OF THE EARTH.

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MAY 17, 1906.

CAUSE FOR CONGRATULATION.

It is a subject for national congratulation that the longshoremen's strike on the great lakes has been terminated so satisfactorily to all parties concerned. The material prosperity of the nation was more closely concerned in this strike than might appear to the casual observer. The United States holds its premier position in iron and steel manufacture to the great abundance of its ore deposits, lying almost wholly in the Lake Superior country. These deposits are not only high in grade, but they are mined so easily and shipped so cheaply that their cost delivered at the furnace door is very low. There is no way for those ores to reach the furnaces except along the chain of lakes. Shipments are so enormous, aggregating last year 34,000,000 tons, that the railways could not possibly handle the traffic were they so disposed. The result is that if the traffic is not handled by ships, it is not handled at all. The continued interruption of this stream of ore for any length of time would paralyze the industries of the United States. Iron is the base of our industrial prosperity. As civilization advances the uses of iron increase. It enters into nearly every form of industrial effort. One can scarcely perform a single act in ordinary business life without the use of iron. It so completely permeates the affairs of mankind that they are practically iron bound. Anything, therefore, that arrests the free use of iron stops the wheels of a thousand industries. The great lakes are America's theatre whereon is played the greatest commercial drama ever written. The states bordering upon the great lakes are the real workshops of this country. These workshops are dependent upon the constant flow of traffic on the lakes. The longshoremen's strike, therefore, did not merely affect the men aboard ship and the men on the docks, but the railways, furnaces, the rolling mills, the foundries, and the hundred and one separate and independent enterprises whose only point in common is that they use iron.

It is not necessary here to discuss or to condemn the causes which led to the strike. It is sufficient that they are removed and that labor has made the most advantageous contract with capital that has been known in years on the lakes. The longshoremen get the same wages they received last year with the added advantage that they work ten hours instead of eleven. Their contract, moreover, is for two years. Working two shifts a day of ten hours each, it is expected that with the aid of the ever-developing automatic machines, the wonderful ore trade of the lakes can be handled in the less than seven months remaining. To do it, however, docks, ships, railways and machines will have to work with shuttlecock regularity. If anyone wants to see marvelous things performed, great courage and skill displayed in the handling of heavy moving parts and automatic machinery brought to its highest pitch, let him visit the docks, both upper and lower, on the great lakes during the balance of this season.

AVERAGE ORE RATE.

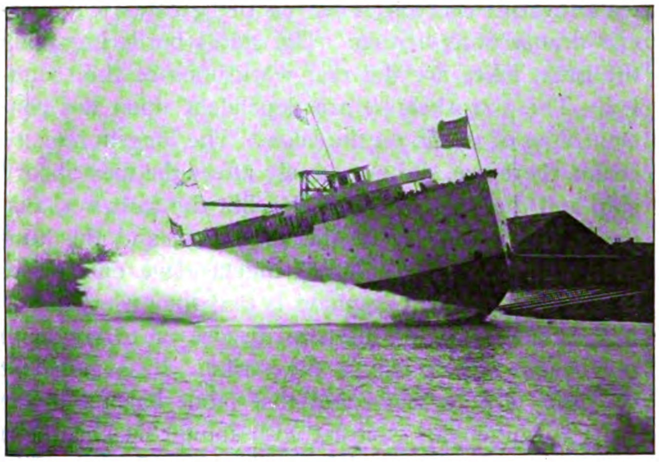
About the most valuable figures that the MARINE REVIEW annually compiles concerning lake commerce are those which show the average rate at which all ore, both wild and contract, was moved from the head of Lake Superior. These figures are obtained directly from the ore shippers. The rate at which all ore was moved from the head of the lakes last year was 75.068 cents. Following is the average ore rate from the head of the lakes for ten years past:

Year.	Average rate Cents.
1905	75.06
1904	72.54
1903	84.01
1902	77.49
1901	79.99
1900	120.7
1899	79.4
1898	59.0
1897	63.8
1896	97.7
1895	85.9

Mr. W. B. Castle, Cleveland agent for the Wolvin line, has resigned to become associated with the firm of James Pickands & Co., at Marquette. The Wolvin boats, including the Acme Steamship Co., the Provident Steamship Co. and the Peavey Steamship Co., will hereafter be handled by Pickands, Mather & Co., of Cleveland.

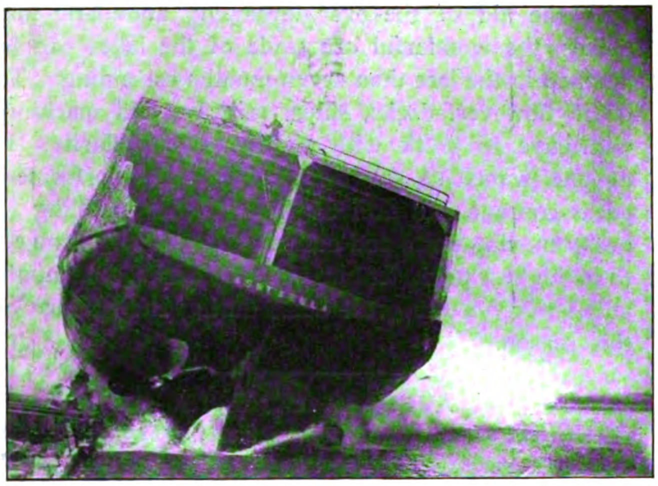
CAR FERRY ASHTABULA LAUNCHED.

The car ferry Ashtabula, which the Great Lakes Engineering Works, of Detroit, is building at its St. Clair yard for J. W. Ellsworth & Co., of Cleveland, was launched on



LAUNCHING OF THE ASHTABULA.

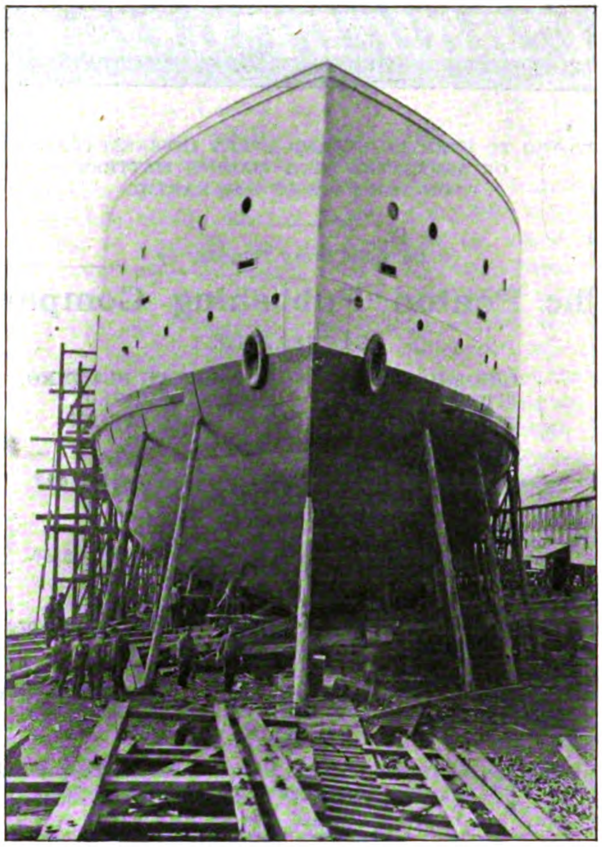
Saturday last. It was a perfect launch and a perfect day. The car ferry was christened by Miss Anne Russel. This new ferry will be operated by J. W. Ellsworth & Co. be-



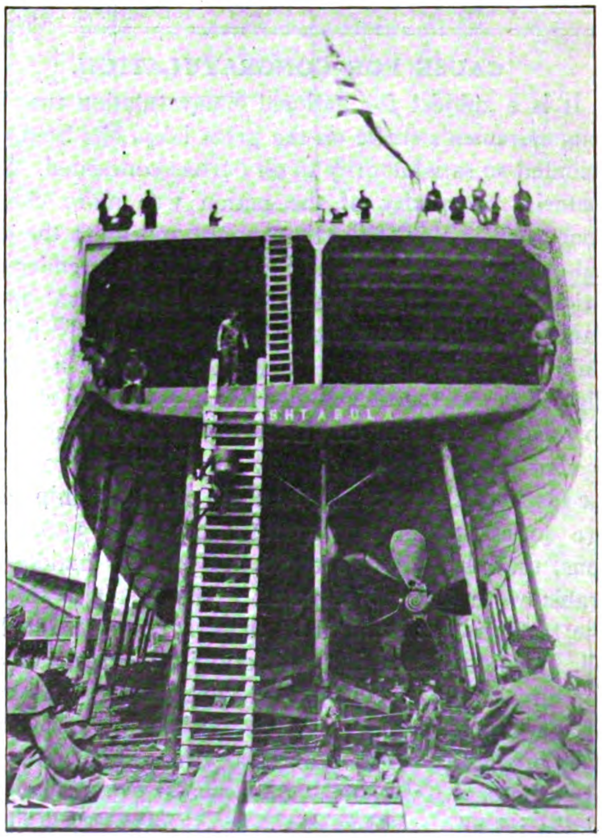
STERN VIEW OF THE LAUNCHING.

tween Ashtabula and Port Burwell in conjunction with the Pennsylvania Railroad and the Canadian Pacific Railroad, and marks the opening of an entirely new enterprise in lake coal traffic. The car ferry is of unusually staunch construction as she will have to operate in heavy ice. The vessel is 350 ft. over all, 330 ft. keel, 56 ft. beam

SHOWING THE GREAT PROPELLERS.



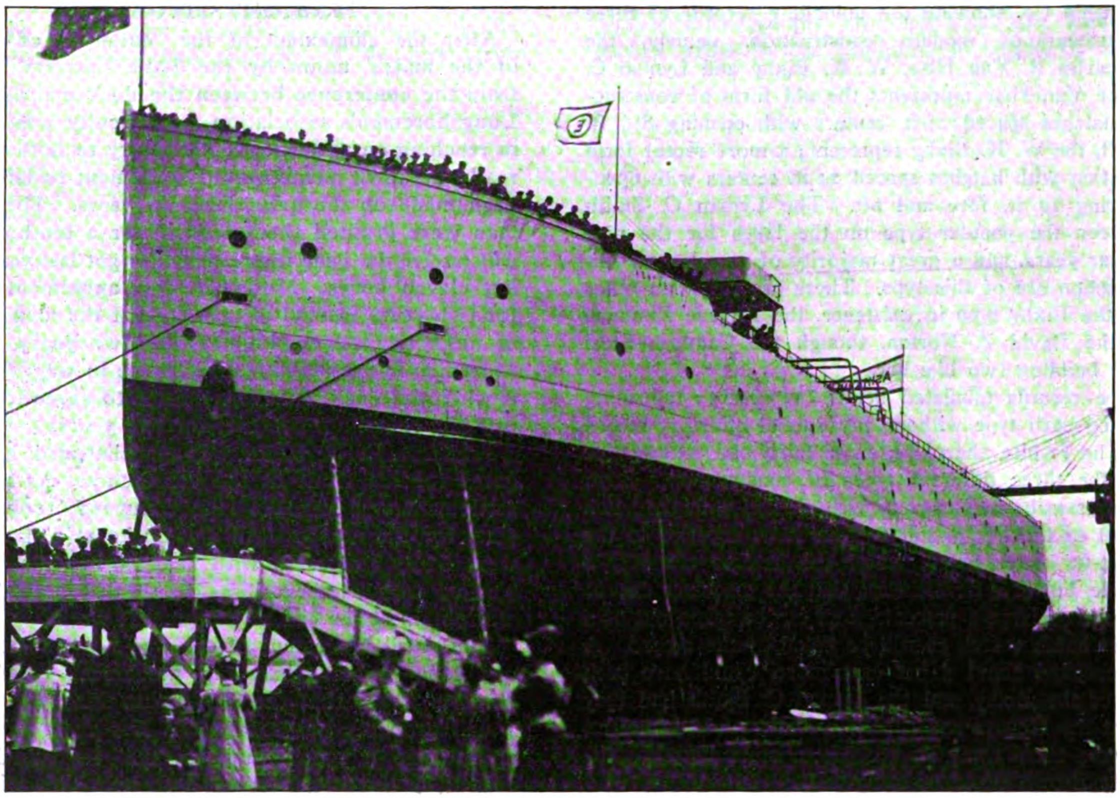
BOW VIEW OF ASHTABULA.



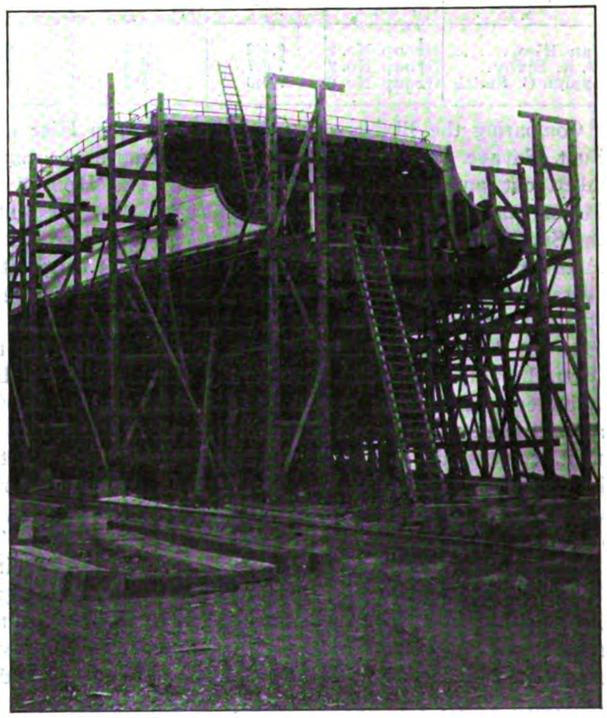
STERN VIEW OF ASHTABULA.

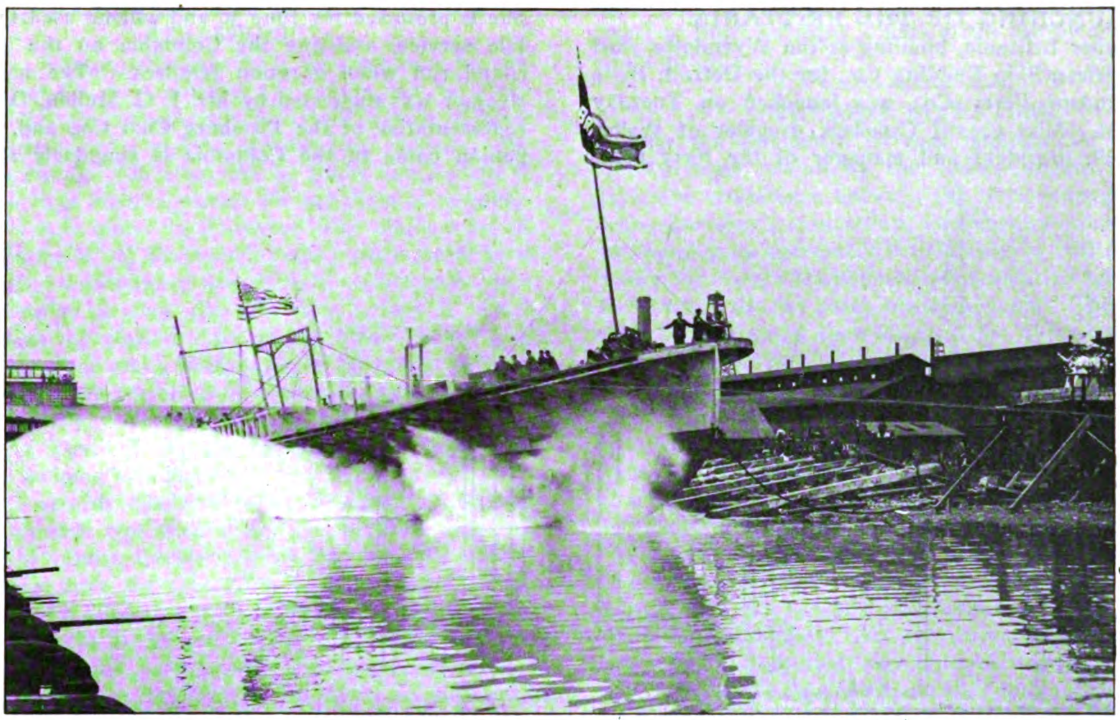
and 20 ft. deep. Twin screws are driven by two triple-expansion engines with cylinders 19½, 31 and 52 in. diameters by 36-in. stroke, supplied with steam from four Scotch boilers, 13 ft. 2 in. by 12 ft., allowed 175 lbs. pressure. The ferry has four tracks and is capable of transferring thirty cars. She will be commanded by Capt. Benjamin Haagenson, an experienced master.

The launching party was taken from Detroit to St. Clair on the private car Yolande, luncheon being served on the return trip. Among those in the party were: Mr. B. F. Berry, representing the Pennsylvania railroad; Mr. Samuel Buchanan, representing the Canadian Pacific railroad; Mr. H. Herriman, of the Great Lakes Register; J. W. Cook, Miss Anne Russel, Miss Stevens, Mrs. R. E. Plumb, Capt. Haagenson, James Fink, Prof. Herbert C. Sadler, H. T. Morley, John R. Russel, George Mattson, John A. Ubsdell and President Antonio C. Pessano.


VIEW OF CAR FERRY ASHTABULA JUST PRIOR TO THE LAUNCHING.


INTERIOR CONSTRUCTION VIEW OF CAR FERRY.


ASHTABULA ON THE STOCKS.



LAUNCHING OF STEAMER BRITTANIA. *Copyrighted, 1906, by Detroit Publishing Co.*

primarily for special winter and heavy ice work aside from the usual excursion business. In designing this steamer several new features have been inaugurated, both in hull design and machinery. The hull forward is cut away and for a distance of 8 ft., 4 ft. above and 4 ft. below the water line, is double plated and double strengthened for a distance of 40 ft. aft of the stem and for this same distance the 6-in.

MR. J. G. MULLEN.

bulb iron frames, which have been used instead of angle frames, are spaced 9 in., while the remainder of the frames are spaced 18 in.

The steamer is 164 ft. between perpendiculars, 180 ft. long, 45 ft. breadth of hull and 17 ft. 6 in. molded depth. The beam, over guards is 56 ft. The shell plating by strakes is as follows: A strake 15 lbs.; B strake 13 lbs.; C strake 12.5 lbs.; D strake 12.5 lbs.; E strake 13 to 20 lbs.; double forward for ice work and G strake is 20-lb. plating double for ice work. E and G strakes, upon which the brunt of the burden in the ice will rest, will be triple riveted, while all other plating will be double riveted, assuring rigidity and strength.

The main deck will be of steel, blind punched throughout to provide a safe foothold for passengers. The engine will be of the triple expansion type, with cylinder diameters 20, 32, 50-in. by 36-in. stroke, and a new departure is made in them in that the low pressure cylinder will be in the center, the high-pressure forward and the intermediate cylinder will be aft, instead of the usual arrangement of high-pressure forward, intermediate in the center and low-pressure aft. All valves will be driven by link motion and the engine will have both steam and hand reversing gear.

The engines will be supplied with steam by two single ended return tube boilers each 13 ft. 2 in. mean diameter, and 12 ft. long, and each containing two 48-in. Morrison suspension furnaces and 2½-in. charcoal iron tubes. The boilers are built to withstand a working pressure of 180 lbs. to the square inch, and will be fitted with the Howden forced draft. Ash guns are provided to dispose of the ashes outboard.

The wheel will be of semi-steel and will be solid, the detachable bucket type not being suited for ice work. It will be 11 ft. in diameter with 13-ft. pitch. The shaft will be 11½ in. in diameter.

The pump equipment will consist of Dean's independent vertical air pump and condenser fitted with suitable valves to connect with the trimming tanks or outboard as may be required. The trimming tanks will have independent outlet valves and there will be a special tank for injection water with at least four seacocks all provided with steam jets for removing ice and a connection is made from the air pump delivery into the injection tank. It will be seen that by this arrangement the new boat cannot get stalled in the ice on account of inability to get water for the condenser, as she is fitted aside from the regular seacocks, with a connection to the waterbottom tanks and is always

able to get water for the condensers and thus assure a steady supply for the air pump.

The water bottom, which consists of five water tight compartments, running above the turn of the bilge, is 40 in. high from the stem to the forward end of the engine space, 30 in. high under the engine space and 48 in. deep from the after end of the engine space to the stern, has connected with it an extra ballast pump connected to each of the five compartments, with a manifold in the engine room, so that it may operate from any one of the compartments or all of them. The engine, ports, pipes and valves are to be proportioned for a speed of 125 revolutions per minute with 180-lb. boiler pressure.

The trimming tanks, one on each side under the deck, will be six ft. wide, 24 ft. long and five ft. high.

All the cabin ...

from this 1,766,329 tons, the amount of ore on dock May 1 less April shipments, we find that shipments during the winter period (Dec. 1 to May 1) amount to 4,672,638 tons, which added to 24,311,720 tons, the amount shipped to furnaces during the navigation season of 1905, (May 1 to Dec. 1) gives 28,984,358 tons as the entire consumption of ore from Lake Erie ports during the year ended May 1, 1906; as against 20,057,070 tons for the year ended May 1, 1905, as against 18,739,995 tons for the year ended May 1, 1904, 21,905,251 tons for the year ended May 1, 1903; 17,216,065 tons for the year ended May 1, 1902; 14,465,260 tons for the year ended May 1, 1901; 15,882,881 tons for the year ended May 1, 1900; 12,122,982 tons for the year ended May 1, 1899, and 10,209,488 tons for the year ended May 1, 1898.

ORE ON LAKE ...

The amount of ore on Lake Erie docks on May 1, of the present year is less than it has been for any year since 1900. The amount of ore on dock May 1, 1906, is 1,791,090 as against 2,271,631 tons for May 1, 1905. Of this amount 24,761 tons were placed on dock during April of the present year. In the following table of movements to furnaces from Lake Erie docks during the winter season the amount placed on dock during April, 24,716 tons, is subtracted in order to preserve the comparative value. The amount on dock Dec. 1, 1905, was 6,438,967 tons, so that during the winter season (Dec. 1 to May 1) 4,672,638 tons have gone forward to furnaces. The total amount of ore moved over Lake Erie docks to furnaces in the full year ended May 1, 1906, was 28,984,358 tons, as against 20,057,070 tons for the year ended May 1, 1905, against 18,739,995 tons in 1904, and 21,905,251 tons in 1903.

Figures showing the total ore passing to furnaces over Lake Erie docks in the year ended with the first of the present month, are found in this way: We know that on Dec. 1, 1905, Lake Erie docks contained 6,438,967 tons; deducting

... The Rutland is a duplicate of the Ogdensburg launched three weeks ago and is of full Canadian canal size. She is 256 ft. over all, 342 ft. keel, 43 ft. beam and 26½ ft. deep. Her engines are quadruple expansion with cylinders 17½, 25½, 37 and 54 in. diameters by 36-in. stroke. Steam will be supplied by two Scotch boilers, 12½ ft. in diameter and 11½ ft. long, fitted with Ellis & Eaves draft and allowed 186 lbs. pressure.

Among those who were in launching party were E. C. Tucker, W. J. Klingman, Mrs. Wm. Sutton, Miss McCormick, Robert Logan, F. W. Gardiner and George Kemp.

A machinists' supply house in New York city received the following postal sent from a little town down in Georgia:

"Deer Sur—Please sen me yore caterlog of supplizes.

"Yores truely,

"____________.

"P. S.—You need not sen it. I have change my mind."

AROUND THE GREAT LAKES

Capt. Henry Larsen, master of the steamer Crate, died of heart failure at Duluth last week.

The north channel at the draw, Houghton, Mich., can now be used by vessels going in both directions.

Capt. J. C. Hazen, a retired lake captain, died at his home at Marine City last night. He was seventy years old.

The lightship Columbia is receiving new boilers and other repairs at the yard of Moran Bros. Co., Seattle,

appropriation for deepening the Saginaw river 12 ft. from Saginaw to Bay City.

The steamer Pere Marquette No. 5 stranded at White Fish Point in a fog last week, but was subsequently released without injury.

The first iron ore cargo ever shipped from Escanaba to go north was taken out by the Canadian steamer Leafield last week. It went to Sault Ste. Marie, Ont.

The Phelps Carey Mfg. Co., of Cleveland, has this season furnished and applied their magnesia boiler covering on over 150 steamers on the great lakes.

The work of laying the keel of the new Detroit and Cleveland passenger steamer is well under way at the Wyandotte yard of the American Ship Building Co.

Groh Bros. and Capt. Wm. Lorenz, Sheboygan, Wis., have given contract to Rieboldt, Wolter & Co., Sturgeon Bay, for a tug to be 83 ft. over all, 20 ft. beam and 11½ ft. deep.

The schooner H. C. Sprague has been converted into a steamer and renamed the Reliance. She will be employed in the sand, gravel and lumber trade on Lake Superior.

Mr. C. M. Stoddard, a well known marine engineer, died at his home in Cleveland last week. He was one of the charter members of the Marine Engineers' Beneficial Association.

Contracts were let at Racine, Wis. this week for the construction of a large freight house for the new Chicago-Milwaukee Transportation Co. It is to be finished in twenty days.

Capt. Z. L. Wood, an old lake master, died at Conneaut last week, aged eighty-six years. He was very active in the early days on the lakes and owned at one time quite a fleet of vessels.

... washed from their

Capt. James Reid, wrecking master, is making good progress in salving the stranded steamer Mataafa. Ore is being jettisoned and the break amidships strapped by beams across the deck.

Clarence Parker, of the Parker Chartering Co., of Detroit, is figuring on a steamer to run between Lorain and Cleveland to take the place of the steamer Frontenac, which has been chartered to run between Chicago and Kenosha.

The Canadian passenger steamer Huronic, bound down with a cargo of general merchandise, struck just before entering the Canadian canal, damaging several plates on the starboard side and filling the collision bulkhead and forward compartments with water.

Bids were opened at Detroit last week for dredging Round Island shoal, St. Marys' river. The lowest bidders were: Shoal 1, M. Sullivan, Detroit, 21½ cents per cubic yard; shoal No. 2, Lake Erie Dredging Co., 49 cents per cubic yard. The sum of $53,000 is available for the work.

The schooner Ellen Williams, bound down in tow of the tug Miner, struck an obstruction in the Detroit river near the lower end of Bois Blanc island and sank in 15 ft. of water on the Canadian side of the river this week. The schooner was laden with lumber and cedar ties for Tonawanda.

Capt. Thos. Donnelly, of Kingston, who is raising the Eugene Zimmerman sunk in the St. Mary's river, reinforces the statement of Capt. C. H. Sinclair that the masters of the steamers Iroquois, Umbria and Hutchinson which struck near the Dyke in St. Mary's river a short time ago, were not at fault. He says that the buoy at the spot

at Evanston, spent last Friday night in an open boat without oar drifting at the mercy of the wind. He heard what he believed to be a call for help and put out alone to investigate. The sea was strong, however, that he lost control of the craft and drifted all night. He was picked up in the morning by the steamer Arthur Orr.

One of the incidents of the longshoremen's strike was the putting back to Duluth of the steamer Nottingham with about 3,000 tons of ore in her hold. One might now paraphase the famous saying "Carrying coal to Newcastle" by "Carrying ore to Duluth." She brought down 7,000 tons, but the automatic machines could only take out 4,000 tons economically, the kind not being one in which they worked well.

The new steamer Sir Thomas Shaughnessy, building at the Wyandotte yard of the American Ship Building Co. for Charles O. Jenkins, of Cleveland, will be launched on Saturday of this week. The steamer E. J. Earling, building at the West Superior yard, for H. H. Oakes, of Detroit, will also be launched on Saturday. The steamer Charles Weston, building at West Bay City, for the Weston Transit Co., will be launched on May 26.

CONFERENCE WITH FIREMEN.

During the past few days the representatives of the Marine Firemen, Oilers and Watertenders' association have met with the executive committee of the Lake Carriers' Association to arrange the schedule of wages for the season of 1906, but so far have not reached an agreement. The firemen and oilers originally made a demand for $52.50 a month from the opening of the season up to Sept.

committee of the Lake Carriers' Association, however, would not meet this program and the conference was declared off. Later the firemen's union decided to submit the proposition to the members of the union, as it was clear that many members of the union are anxious to have the matter settled. A referendum vote will be taken upon the subject in a few days and the Lake Carriers' executive committee are confident that the schedule of wages offered—$45 up to Oct. 1 and $65 thereafter—will be accepted.

The officers of the Great Lakes Towing Co. are now meeting with the representatives of the various tugmen's associations. Agreements have been reached upon every point except the one of time off. The men want every other night and every other Sunday off. The company is willing to grant the men every third night and every third Sunday off, the same as last year. It is expected that an agreement will be reached during the present week.

SCIENTIFIC LAKE NAVIGATION.

By Clarence E. Long.

Decimal Fractions.

PART V.

The decimal system is a system of reckoning by tens or tenths. Decimal arithmetic or decimal fractions is one of the most important branches of mathematics used in connection with the practice of navigation; and since calculating with decimals enters so largely in the problems of navigation, the student should thoroughly master the subject. A decimal is f...

point, as first, second, third, place, etc.

Decimal point, a dot or period used to separate a decimal fraction from a whole number, or to indicate its fractional character when standing alone.

In setting down a decimal fraction, the numerator must consist of as many places as there are ciphers in the denominator, and if it has not so many figures, the defect must be supplied by placing ciphers before it; thus, 14-100 =.14; 14-1000=.014; 14-10000=.0014, etc. And as ciphers on the right hand side of whole numbers increase their value in a tenfold proportion, as 2, 20, 200, etc., so when set on the left hand of decimal fractions they decrease their value in a tenfold proportion, as .2, .02, .002, etc., but ciphers set on the right hand of these fractions make no alteration in their value, neither of increase or decrease; thus, .2 is the same as .20 or .200.

As we have seen in common fractions, the unit or whole number (represented by the denominator) may be divided into any conceivable number; but not so in decimal fractions—the denominator is based upon the power of 10, or the unit is divided into either 10's, 100's, 1000's, etc. The numerator may be the same in either case. This notation and numeration of the decimal denominator into 10, 100. 1000, etc., is what render decimals so serviceable, since the common arithmetical operations can be performed the same way as they are in whole numbers; regard being had only to the pa...

... removal one place to the right; hence:

The figure at the *right of units* expresses *tenths.*

The figure at the *right of tenths* expresses *hundredths.*

The figure at the *right of hundredths* expresses *thousandths.*

The figure at the *right of thousandths* expresses *ten-thousandths.*

The figure at the *right of ten-thousandths* expresses *hundred-thousandths,* etc.

The *first* place is *tenths;* 2 places *hundredths;* 3 places *thousandths;* 4 places *ten-thousandths,* etc., that is, the number of places or figures, to the right of the decimal point.

Rule.—Read the decimal just as you would a whole number, and give it the denomination of the right-hand figure, that is, if the right-hand figure is only one place from the decimal point, the denominator is *tenths;* if two places from the decimal point the denominator is

hundredths; if three places from the decimal point the denominator is *thousandths,* etc.

Express decimally seventy-nine thousandths.

Explanation.—Since thousandths occupy the third place, three figures are required to express the decimal. Hence, the number seventy-nine is written, and a cipher prefixed to cause the figures to occupy their proper position. Hence, the decimal is written .079.

Rule.—Write the numerator of the decimal just as you would were it a whole number, place ciphers before it if necessary to indicate the denominator, and place the decimal point before tenths.

Express decimally:

Three *tenths* = .03.

Four *hundredths* = .04.

Five *thousandths* = .005.

Fifteen *hundredths* = .15.

One-hundred thirty *thousandths* = .130.

Three hundred four *thousandths* = .304.

Twelve *hundred-thousandths* = .00012.

Sixty-seven and three hundred forty-nine *ten-thousandths* = 67.0349.

Fifteen *hundredths* = .15.

Seven *thousandths* = .007.

Nine *ten-thousandths* = .0009.

Principles.—Annexing ciphers to a decimal does not alter its value. Each decimal cipher, prefixed to a decimal, diminishes the value of the decimal ten-fold. The denominator of a decimal, when expressed, is 1 with as many ciphers annexed as there are figures in the decimal.

Notation and Numeration of Decimals.

7 tenths, or 7-10, is written .7

4 hundredths, or 4-100, is written .04

9 thousandths, 9-1000, is written .009

69 ten-thousandths, or 69-10000, is written .0069.

Note.—In the foregoing examples, it will be observed that the number of places to the right of the decimal point is equal to the number of ciphers in the denominator of the corresponding fraction.

To write a decimal, write the numerator, and from the right, point off as many decimal places as there are ciphers in the denominator, prefixing decimal ciphers, if necessary.

Note.—Ciphers between the decimal point and the first significant figure of the numerator are called *decimal ciphers.*

Numeration Table for Facilitating the Reading of Decimals.

The reading of DECIMALS and WHOLE NUMBERS to each other is clearly shown by the following table:

—Millions.	—Hundred-Thousands.	—Ten-Thousands.	—Thousands.	—Hundreds.	—Tens.	—Units.	—Decimal Point.	—Tenths.	—Hundredths.	—Thousandths.	—Ten-Thousandths.	—Hundred-Thousandths.	—Millionths.
7	6	5	4	3	2	1	.	1	2	3	4	5	6
	6	5	4	3	2	1	.	2	3	4	5	6	
		5	4	3	2	1	.	3	4	5	6		
			4	3	2	1	.	4	5	6			
				3	2	1	.	5	6				
					2	1	.	6					
						1	.	0					

Whole Numbers. Decimals.

3 4 1 5 6 7 3 . 4 1 3 2 0 7

The number is read, 3 million, 415 thousand, 673 *and* 413 thousand 207 millionths.

The order of decimals below millionths are ten-millionths, hundred-millionths, billionths, ten-billionths, hundred-billionths, trillionths.

1......Unit	1	. 2................	Tenths
20.....Units	20	. 03..........	Hundredths
300....Units	300	. 004........	Thousandths
4000...Units	4000	. 0005...	Ten-Thousandths
50000..Units	50000	. 00006..	H'd'd-Th'sandths

The position of the decimal sign indicates the denominators, and determines the value of the decimal expressions.

The *denominator* of a decimal fraction is always 10, 100, 1000. etc., or 1 with as many ciphers annexed as there are figures in the given decimal. Thus, .4 = 4-10; .09 = 9-100; .007 = 7-1000, etc.

The *numerator* of a decimal fraction when alone, must have as many decimal places as there are ciphers in the denominator. Thus, 8-10 = .8; 12-100 = .12; 125-1000 = .125, etc.

When a whole number and decimal are written together the expression is a *mixed decimal.* Thus, 7.12 and 16.134 are mixed decimals. The word *and* is used in reading mixed numbers or mixed decimals to separate the whole number from the common fraction or the decimal. Thus, 7.12 is read 7 and 12 hundredths, and 26.134 is read 26 and 134 thousandths.

Note.—When all the decimal places are occupied by figures instead of ciphers, it is easier for the beginner to read the decimal; thus, .25. When one or more ciphers are prefixed to a decimal number read just the numbers that follow the ciphers; the prefixed ciphers have no value only in indicating the denominator. Thus, .0025, is twenty-five ten-thousandths. .0105 is read one-hundred five ten-thousandths, etc.

The expression, decimal place, or places, means the number of figures to the right of the decimal point. The first place, or figure, is tenths, or one decimal place, as .5; the second decimal place is hundredths, or two places, as .05; the third decimal place is thousandths, or three decimal places, as .005, and so on. See numeration table for this information. This table will show you that all places to the right of the decimal point are fractional parts of a whole one, while all those figures to the left of the decimal point are whole numbers or units. Bear this in mind.

To Read the Denominator.—Decimal fractions are sometimes considered much easier learned than common fractions. Now, we'll see what we can do with them. As you have seen the decimal point with the figures after it determines what the denominator is or should be. The decimal point is never read only in mixed numbers, then it is called *and.* Now, if it bothers you to read decimals do as follows: Write both the numerator and denominator, and then read it as you would a common fraction; thus, .07 = 7-100, read 7-hundredths; .125 = 125-1000, read 125-thousandths, etc. But, if it bothers you to write the denominator from only seeing the numerator, here is a little point that will help you. The denominator of a decimal fraction always consists of one figure or place more than the numerator, and that figure is always 1 with a certain number of ciphers placed to the right of it; the number of ciphers depending upon the number of places or figures to the right of the decimal point in the numerator. Or, still better, put down a cipher after the figure 1 for every figure in the numerator; for instance, .5 (5-tenths), put down the figure 1 and add a cipher to it for the 5, which makes 10, or 5-10. Again, .25 (25-hundredths), put down 1 and add a cipher to it for each figure in the numerator—a cipher for 2 and a cipher for 5, or in other words 100 is the denominator, and is read 25-100, and so on. Here is another simple way of remembering

it: When the decimal is written and it bothers you to read it, do as follows: Write the figure 1 directly under the decimal point, then add a cipher for each separate figure to the right of the decimal point, and you have its denominator; thus, .135-1000, read 135-thousandths.

ANSWERS TO CAPTS. HOAG AND SAWYER.

MARINE REVIEW, Question Department:—I have taken the liberty to write you in regards to two examples taken from ranges in Soo river above the canal locks and would like to know why the var. in these two examples which is westerly, that in the first example the westerly var. is allowed to the right, and in the second example the same amount of var. is allowed to the left in the same quadrant. The following examples will explain what I am trying to get at.

WILLIAM S. HOAG, Master Str. Sir Henry Bessemer.

Example No. 1.—Vidal Shoal Channel Range (Soo Canal Ranges) over stern the true bearing of which is WSW ¾ W var. 2½° Wly. = ¼-pt. making the correct magnetic bearing of the range W by S. With the range directly over the stern the compass should read W by S if there is no dev. If it should read west of west by south the dev. is Wly., if south of W by S the dev. is Ely., the amount depending on the difference of what the compass shows and W x S.

Example No. 2.—Pt. au Pins Range true bearing of which is S W ¾ W var. 2½° Wly. = ¼-pt., which makes the correct magnetic bearings S W ½ W. If your compass reads anything to the West of S W ½ W the dev. Wly.; if South of S W ½ it is easterly; if the compass should read S W ½ W itself there is no dev. and the compass bearing is also the correct magnetic bearing.

William S. Hoag, Master Steamer Sir Henry Bessemer:—You are right; it is my mistake. The correct magnetic bearing of the Pt. au Pins range in the Soo river is SW by W instead of SW ⅛ W. I allowed the var. the wrong way—to the left of the true course instead of to the right of the true course SW ¾ W. On page 261 of *Nautical Magazine* you will find where I called attention to this and made the proper correction. From true course or true bearing, to correct magnetic course or bearing, allow or apply westerly var. to the right of the true course, and easterly var. to the left of the true course. Ely. and Wly. dev. is applied the same as Ely. and Wly. dev. from correct magnetic course or bearing, to compass course or bearing.

Thanking you for your favor and inviting you to come again, LONG.

Reply to query of E. L. Sawyer, master steamer Griffin, printed in last week's REVIEW under the heading of "The Subject of Deviation": All that you have said is very true; you have the correct idea of dev. and understand its changes under the conditions which you have named. You have merely misconstrued the passage quoted from my article.

I will quote the whole paragraph from which the passage is taken, and then analyze it:

"The uninformed master entertains the idea that because this range and course are one and the same true directions that whatever the compass reads when his boat is on with the range, represents the course to be steered by that particular compass from Eagle harbor to Devil's island. These true directions are nevertheless the same, but it is the change in the name of the var. that accounts for it, the dev. taking no part in the problem, because it remains the same for that heading of the vessel whether in the Soo river or on Lake Superior, providing, however, that the change of latitude is not too great. Where the name and change of the var. is of the same name and amount, this practice is sufficiently accurate for all practical purposes; in fact, it is used a great deal and with good results, but it will not work on the same principle all over the lakes for the reason that the var. is not of the same amount and name."

This article presupposes that the boat in question is bound up to the head of Lake Superior. She may be light, or loaded, or only half loaded, or otherwise, but whatever trim she is in at the time of determining the dev. on this range she must retain this same position in the water in order that the same influence on board causing the dev. will remain the same in respect to the compass.

The statement that "the dev. taking no part in the problem, because it remains the same for that heading of the vessel whether in the Sault river or on Lake Superior," is true under the conditions named. It must now be understood that the amount of the dev. found while the boat was on the Soo range will be identical with the amount with the boat heading correctly on the course between Eagle harbor and Devil's island. Now, the point I endeavored to bring out in the article is simply this: that the geographical direction of the Soo range is identical with the geographical course between Eagle harbor and Devil's island. The uninformed master will put his boat on this range, note the compass course, and then try and make the same compass course between Eagle harbor and Devil's island, as the compass said on Soo range. It cannot be done, simply because the var. is not the same at the two places. The dev. is though; therefore, the dev. takes no part in the problem (when it is combined with the var. as in this case), because it remains the same for this particular heading of the vessel whether in the Sault river or on Lake Superior. It is the change of the var. that is responsible for throwing the vessel off the course. This then proves the statement made in regard to the dev. having nothing to do with it.

The statement: "providing, however, that the change of latitude is not too great," is of no account in this case. It has reference to the changes of dev. due to changes of the earth's magnetism in sailing over a wide expanse of the earth's surface, such as the change of dip with its influence on vertical iron on board.

Your letter virtually indorses the sum and substance of the article entitled "What Every Master Should Know."

You might well have said that there is no place in the world where scientific piloting is more essential or more required than here on the great lakes. There is no other navigation where the course made good is of such prime importance; on the ocean, with plenty of sea room, this is not so important, since the ship's position is found from time to time by astronomical observations.

I regard the principles of true piloting the most serious problem of navigation. There is much more to the subject than many practical men have an idea. Lake piloting is not sea harbor piloting, nor is it to be compared with it, and, too, it is more difficult and requires more science than sea coast navigation. Scientific piloting does not simply mean being acquainted with the shore lines, land marks, lighthouses, reefs, buoys, etc., etc. These, of course, are the first principles of the science and the foundation upon which based; but true lake piloting is dependent upon a thorough understanding of the causes and effects of var. and dev.; a knowledge of the use of pelorus and azimuths in ascertaining the dev. and its changes; the taking of bearings of prominent points, lighthouses, and other objects depicted on the chart, and from the plotting the position of the vessel on the chart at regular intervals; also the familiar use in laying courses and correcting same for var., dev., leeway, etc.; a judicious use of the sounding lead in connection with safety curves in getting the required information from the bottom during thick weather, etc., etc. I don't mean by this that one has only to know navigation in order to become a skillful pilot navigator. It requires experience and good judgment together with scientific training. One is of little use without the other, especially in thick weather. One who learns the theory of the science first will acquire its practice much quicker than one who has only the practice and not the theory.

A knowledge of navigation gives the master of a vessel

confidence and a feeling of self-assurance in his work. It makes him independent in a large measure, of courses and distances steered and run by others, for he has the ability to accurately direct the course of the vessel through tortuous channels with hidden dangers on either hand, and along treacherous coasts enveloped in fog, with compass deviations continually changing, and the safety of the vessel depending upon the accuracy of the calculated deflection of the compass needle. The man with superior navigation ability holds the key to the situation and he is master of the position at all times. Such knowledge is furnished by scientific training, which under all conditions and circumstances, is a never-failing aid, and therefore superior to the stand-off-shore-till-it-clears navigation of the two-foot-rule-order.

Azimuth is of no account in thick, foul and cloudy weather, and where you have such weather on an entire trip with the dev. different for different trim of your boat, the master is "up against a stiff proposition." The only method of determining or verifying the dev. then is by harbor piers, harbor ranges and the ranges in the rivers. These river ranges afford an easy and accurate method of ascertaining the dev. of the compass when azimuths cannot be taken. It should be employed by the master at all times. It should be employed as a check in azimuth work. Every master of ability is continually on the lookout for opportunities of this kind. Of course, the next thing is to get to the rivers in thick weather in order to get the ranges. Coming down Lake Superior from its head is the worst and most dangerous in thick weather without a proper knowledge of the course. Running the Soo river the ranges will give you the desired information for a table of dev. for all courses to be steered on the lower lakes. You have another chance to verify it in the St. Clair and Detroit rivers on their ranges. Lake Erie ports to Southeast shoal are not so difficult to make in thick weather as the courses on Lake Superior, though bad enough when you are not sure of your compass. The only proper way of verifying a vessel's position in thick weather is by "chain of soundings" employed in conjunction with safety or fathom curves on the chart. To perform this accurately it is necessary to have a patent sounding machine, which does the work automatically. With one of these machines a vessel can go at any speed and regular soundings can be taken at regular intervals without the least trouble and at any time. The master can control the entire situation personally from the bridge. A fathom curve is a continuous line drawn, or laid down on a chart, that passes through soundings of the same depth. Take the 10-fathom curve for an example; a continuous line is drawn connecting each sounding of 10 fathoms. These curves are of great benefit and assistance to the navigator, for in making harbor, a turning point, or otherwise, in thick weather, either from the non-dependence of fog whistles, or from being unable to hear them, or from the vessel being off the course she is supposed to be making good, either from a wrong dev., a change in the dev., leeway, or current, or otherwise, the vessel by keeping outside (by use of the lead) of this curve cannot get aground, provided, of course, that the vessel's position is approximately known, and that there is no obstruction within these limits. If this be so then a safety curve of greater depth must be employed to guide and keep the vessel into safety. These curves are very irregular as will be seen from looking on a chart which contains them. Except in places of harbors that have been surveyed in detail, the five-fathom line laid down on charts should be considered as a caution or danger signal against unnecessarily approaching the shore or bank within that line. The 10-fathom curve on rocky shores, is another warning especially for vessels of heavy draught.

It has always seemed strange to me that the patent sounder has not found its way on lake vessels. Ocean liners could hardly do without them in making the land, or in shoaling the water on banks or otherwise. If they are of such great service on the seas they would be doubly do in our navigation on acocunt of making the land and shoaling the water and changing the course so frequently. Ocean liners making from 15 to 18 knots get soundings and specimens of the bottom in 100 fathoms of water without stopping with these machines. By the way, I have prepared an article demonstrating its use in this connection which will soon be published in the REVIEW. Some practical tests of the machine are to be made on lake boats before long. A report of the results will be published in order to show what can be done with them in finding the position of a vessel in thick weather. No matter how correct a compass may be it cannot overcome bad steering, leeway, current, etc. Without soundings and a sample of the bottom there is no way of verifying the position of a vessel in thick weather when fog signals cannot be heard, or where they do not exist. Soundings and their comparison with those on the chart are as essential for finding position in thick weather as lighthouses, landmarks, headlights, etc. are in plotting the position in clear weather. Where the dev. is so changeable as in most lake ports from different positions of the hull in the water the use of the patent sounding machine must be fully apparent in determining the position of the vessel when there are no other means at hand.

In thick weather a vigilant lookout is not of much use, neither is a mere familiarity with the chart, courses distances, shoals, buoys, lighthouses, fog signals, and the frequent use of the lead is in itself no safeguard at all. Safety in thick weather depends on such factors, as, for instance, a knowledge of the principles by which strandings are prevented; the shaping of courses so as to be easily controlled by the lead. It is not the frequent use of the lead, but its time and judicious use, which ensures safety. Compass and log cannot be depended upon since both can be influenced by the currents. From all this follows the necessity of a thorough knowledge of all the principal methods used to avoid these dangers in thick weather. Without scientific training no one is able to intelligently navigate a vessel and keep her out of danger in thick weather, the numerous strandings in proof thereof.

I note what you have to say in regard to a boat lying idle, or in one direction all winter. This is termed "Retained Magnetism." When a vessel's head has been in one direction for a long time, the hull becomes temporarily magnetized in a direction parallel to the magnetic meridian, owing to the earth's inductive force. This change sometimes amounts to as much as 15°. Lying near a large pile of iron ore during this time or alongside of several other steel vessels, as you say, would have the effect of intensifying this retained magnetism. This, however, is no fault of the compass. It is from the influences of this retained magnetism on the compass needle that is responsible for it. This abnormal condition becomes normal after a while and the ship's magnetism settles down to its original state. Every steel vessel lying in one direction like this all winter ought to have her head reversed at least a week before starting out in the spring. This temporary magnetism goes more quickly when the direction of the ship's head has been reversed than otherwise. I am gratified to hear that you depend so much on the pelorus and azimuths and that

you have such good success. This is highly proper and is as it should be.

In conclusion I wish to say that it is simply impossible for one to explain himself on the subject under discussion in so limited a space. I find it difficult to write on so many subjects without going into detail. All these subjects will be brought out in detail before the lessons are completed. If you do not thoroughly understand all that I have said and you desire more information let us hear from you as many times as you like. This is what this department is for. I wish to thank you especially since you are the first to start the "ball rolling" in the right direction. You are not afraid to say what you think, and this is commendable in you.

LONG.

SUBMARINE SIGNALING.

Mr. J. B. Millet, the president of the Submarine Signal Co., of Boston, delivered an exceedingly interesting lecture on "Submarine Signaling by Means of Sound," in London, on May 2. In the course of his address Mr. Millet traced the history of his company from its birth in 1895, this interesting event happening in consequence of Mr. A. J. Mundaz, one of the chief inventors, trying to devise means of utilizing a telephone receiver for hearing the sounds produced under water. After describing a number of experiments made on the New England coast the lecturer said that eventually the old frigate Constitution, with its 22-inch oaken walls, proved to be an excellent conductor of submarine sounds. In order to carry on extended observations, arrangements were made for the use of four steamers of 3,000 tons each, plying between Boston and New York, and permission was obtained from the United States lighthouse department to place submarine bells on three lightships on the route. From this time the operations of the company were conducted along lines which led them to success on a practical basis.

The existing sound-producing apparatus used by the company is as follows:—First, a bell weighing 160 lbs. operated by compressed air and perfected for use on lightships. This is suspended over the side of the vessel and lowered about 25 ft. below the surface. The blows are controlled by a code-ringing device in the engine-room, under the supervision of the officers, so that each lightship rings its own number. Second, a bell of similar weight, supported on a tripod placed on the floor of the ocean and operated by electricity sent along a cable from a power-house on shore. Third, a buoy supporting a submarine bell of like weight, some 25 feet below the surface. Situated above the bell is a disc working on the principle of a sea anchor; the difference in movement between this and the buoy operates a mechanism known as the "accumulator," by which the bell is struck with uniform force. On a calm sea the blows will, of necessity, be less frequent than when the waves are larger, but a wave of only 6 in. in height will give sufficient energy to produce two blows per minute.

The tones of these bells have a range varying from six to twelve miles, according to the draught of the observing steamers. The pitch of the bells can be varied by altering the thickness of the rim, or by increasing the diameter. Those used in the earliest experiments weighed 1,000 pounds, and were cast for church steeples. Practice showed that the higher overtones of these bells were weak, while those very notes possessed the most penetrating qualities. In order to strengthen these tones, bells less than one-half the diameter, and weighing only 150 lbs. were cast, with a peculiarly thick lip, and these were found to produce a very high clear note. This diminution in the size, and decrease in the weight of the bell, greatly simplified the problem of designing a practical bell buoy. It was even found that a bell 4 in. in diameter gave a high tenor note that penetrated the walls of the steamer at a distance of three miles. One of the puzzling results of experiments was that instruments which gave a poor musical tone in the air often proved singularly efficient in water.

The apparatus for receiving the sound consists, firstly of two metal tanks about 22 in. square, filled with sea water, fastened securely against the skin of the ship below the water line, and not less than a demonstrated distance from the fore foot. Secondly, a specially designed microphone suspended, wholly immersed, in each tank. Thirdly, wires connecting these microphones with an indicator box on the bridge. This box is of metal, circular in shape and is fitted with two telephonic ear pieces, or receivers, enabling two observers to listen simultaneously. By moving a switch the listener can hear instantly the sounds of port or starboard at will. As a provision against accident, a second set of microphones is placed in each tank, and by manipulating another switch on the indicator box, the operator is able to connect either set.

The method of using the apparatus is remarkably simple. Let it be supposed that a ship equipped as above is coming within range of the sound of a submarine bell. The observer, with the receiver to his ear, listens to starboard and port alternately by quickly turning the requisite switch. Presently he hears the unmistakable, high, musical note of the bell, and referring to the face of the indicator, can tell from which side the sound emanates. He then connects with the other side, and if the note of the bell can be distinguished there also, the observer knows that the ship is heading in the general direction of the signal. It then becomes his duty to compare, by turning the switch to and fro, the intensity of the bell notes on starboard and port sides. Experience has shown that by this method the bearing of the submarine bell can be rapidly determined to within less than a quarter of a point. Of course, if the bell is abeam or nearly so, the sound will only be heard on that side. These observations can be made when the vessel is proceeding at its full speed, and, under such conditions, signals have been often accurately located at distances up to ten nautical miles. In foggy or thick weather, when speed is reduced, the diminution in the ship's noises enables the observer to hear the bell at greater distances. These results are valuable, not only on account of the long range of the signal, but because the direction can be accurately determined under all weather conditions, whereas it is notorious that sound-signals in the air are wholly untrustworthy. A remarkable illustration of this fact recently came under my notice. A party of observers set out to test the sound-range of a siren on a lightship. The conditions were favorable—a calm sea and a clear, still air. The boat approached nearer and nearer the lightship, but not a sound reached the cargo of listening experts. At a distance of 600 yards, without the slightest warning, these gentlemen were all deafened by an apparently sudden roar from the siren, which continued until they boarded the lightship. Inquiry amply proved that the instrument had been sounding at its full pitch, continuously for over three hours.

I do not suggest, however, that sound-signals in the air should be superceded. This invention is intended as an aid to navigation.

After quoting testimonials received from the captains of vessels belonging to the Cunard line, the Norddeutscher Lloyd line, and the officers of the U. S. navy ships, Mr. Millet said that it is, however, to the lighthouse establishment of the United States and to the Department of Marine and Fisheries of Canada that our company is most deeply indebted. Such success, and such honor attaching thereto, as has attended the work of the Signal company

is due in large measure to the encouragement and courteous assistance of the officers and officials of these departments.

The authorities at Washington welcomed our earliest attempts; by granting access to the lightships between Boston and New York, they afforded the opportunity to install submarine bells with which to develop a practical system. Canada was the first officially to adopt it, and at the present time submarine signals are being rung in thick weather at and near the port of Halifax and at several points in the St. Lawrence river. Twenty automatic buoys are being constructed having submarine bells, and, within a few months, these are to be placed along the dangerous coast that stretches eastwardly and northerly from Halifax towards Sable Island.

Beyond the sphere in which activities are at present applied, there lie the suggestions of many possibilities. Already on the New England coast the experiment has repeatedly and successfully been made, of equipping a steamer with a bell submerged in a tank in her fore-peak. To those ships which are supplied with receivers this bell heralds the approach of the vessel in all weathers. So much success has attended this development of the work that the company is now devising a sound-producing apparatus specially adapted therefor. Along these lines lie the hope of efficient signaling between members of a naval squadron. There is, moreover, a probability amounting, in my mind to certainty, that the movements of submarine boats can be directed and messages exchanged between them as well as with their headquarters.

Above all, gentlemen, I must ask you to believe that by pursuing the logical development of our present endeavors, we shall see that day when not only will the protectors of our national coast line be rendered more efficient and deadly, but the safety of those peaceful mariners who bear the measure of commerce the world over, will be divested of its most dreaded menace, and "collision at sea" be thenceforward unknown.

MILWAUKEE THE THIRD LAKE PORT.

Milwaukee harbor stands third among the five leading lake ports in the receipts and shipments of freight during the calendar year 1905, according to a statement compiled by United States Engineer W. V. Judson. The five ports enumerated are Buffalo, Chicago, Milwaukee, Cleveland and Duluth. The total amount of freight that entered this port the past year was 12,901,196 tons, comprising a value of $198,224,513.95. In valuation Buffalo and Chicago exceed Milwaukee, the former with $364,859,682.43 and the latter showing $327,458,090.55. In tonnage Chicago is first with 14,783,619, Duluth second with 14,506,408 tons, Buffalo comes fourth, totaling 11,574,171, and Cleveland is last among the five ports, scheduling 10,538,230 tons. The valuation of the Cleveland and Duluth receipts and shipments is $147,344,821.76 and $110,791,180.10 respectively.

The largest item in the valuation column for Milwaukee is flour, of which commodity 3,088,760 tons, valued at $60,061,552, was handled in this port. Of coal anthracite and bituminous, 815,351 tons of the former and 2,197,998 tons of the latter were received. Nine hundred thousand tons of wheat were shipped and received at this port for the same year, which was worth $884,888. Other grains aggregating 9,880,463 tons were handled in the Milwaukee harbor. Iron ore was received to the extent of 232,000 tons, and 40,335 tons of manufactured iron were received and shipped. Lumber is another significant item in the table, 146,549 tons being handled, valued at $2,710,156. The smallest item is copper, of which but 2,903 tons entered the port of Milwuakee in 1905.

TEST OF FALLS HOLLOW STAYBOLT IRON.

The Falls Hollow Staybolt Co., Cuyahoga Falls, O., has recently received large orders, for Falls hollow staybolt iron, from the Royal railway of Saxony, the New Zealand government railways, the Farro Carril Payta Piura railway of Peru and from three leading railways of Japan. Furthermore, they are furnishing over one hundred leading railways of the United States, Canada and Mexico with Falls hollow iron for repair work, also large quantities to the Baldwin Locomotive Works, for new equipment in which Falls hollow iron was specified. The following report of test of sixteen samples of Falls hollow staybolt iron by the Baldwin Locomotive Works indicate its superior quality:

Philadelphia, Pa., March 23, 1906.

H. V. Wille, Asst. to Supt.,
Baldwin Locomotive Works.

Dear Sir:—

We have made tests of the samples of Falls hollow staybolt iron sent us March 8, and report as follows:

AVERAGE RESULT OF 16 TEST SAMPLES 1 IN. O. D. X 3-16 IN. I. D. HOLLOW STAYBOLT IRON.

Tensile strength	50,833 lbs. per sq. in.
Elongation	32.33%
Reduction of area	49.1%
Threading test	O. K.
Double Bending test	O. K.

Vibratory test:

The threaded specimens stood an average of 7,713 revolutions when subjected to a deflection of 3-32 in. and a tensile load of 4,000 lbs.

Etching test:

Etching test shows the iron to be slab piled.

This make of iron meets our proposed new specifications in every respect.

P. WEEKS, Engr. of Tests,
Baldwin Locomotive Works.

BIDS FOR TUG AND BARGES.

Bids were opened April 27 at the office of David W. Ross, general purchasing agent, Isthmian canal commission, for one sea-going tug boat, new or second-hand, and for six steel dump barges delivered at Colon. Bids were as follows: Tugs—George Archer, New York, $42,000, $52,000, $60,000, or $58,000, ready for delivery; Angus Cameron, Baltimore, $41,000, delivery seven days; James Clark & Co., Baltimore, $47,500, $50,000, $52,500, $55,000, delivery not less than 42 nor more than 56 days; Bernard Tucker, Philadelphia, $52,500, prompt delivery; John Dunn, Key West, Fla., $13,000; Merrill-Stevens Co., Jacksonville, Fla., $47,500; Spedden Ship Building Co., Baltimore, $72,000, $65,000, delivery 40 days; W. E. Streeter, $38,000, $50,000; Propeller Towboat Co., Savannah, Ga., $30,000; Roderman Bros., New York, $41,750, delivery 60 days; Samuel Holmes, New York, $65,000, $42,000, $45,000, $53,500, $83,900, $53,400, $63,900, $43,500, $35,000. Barges—Merrill Stevens Co., Jacksonville, $180,000, $201,000; W. S. Streeter, $63,000.

OBITUARY.

John Lucas & Co. announce the death of Albert Lucas, one of the trustees of the firm, which occurred Tuesday evening, April 10, at Philadelphia.

Capt. Charles Lindstrom, aged sixty-one years, government lighthouse keeper for twenty years, died last week at Muskegon. He spent nearly forty years of his life in government service.

PROGRESSIVE CHAIN MANUFACTURERS.

Mr. Eli Attwood, the president and general manager of the Lebanon Chain Works, in order to provide for his company's increasing business, recently contracted for and bought out complete the Empire Chain Works and the Chilcote-Evens chain plants located in Pittsburg, moving the contents of those well known chain concerns to Lebanon and installing it in his company's new shops. In connection with the Lebanon company's new plant, they operate a rolling mill enabling them to turn out special stock from their own formulas and mixtures. This places the company in a position to furnish products to comply with the conditions, demands and requirements that may be necessary for chains required for special purposes. The company operates its own foundry in which they make the chain studs for their heavy ship cables as well as all descriptions of light and heavy castings. They have also added a forging department and machine shops. The plant being situated close to the iron ore and coal districts gives them a decided advantage in competition with other chain manufacturers.

This chain works first became especially prominent when they secured the order for the ship cables (the heaviest ever made) that were required for the steamships Minnesota and Dakota (the largest freight carriers in the world) built at the Groton yards, to ply between the coast and the orient. These cables were manufactured at the Lebanon shops, under Mr. Attwood's personal supervision; they were made from 3 3-16-in. iron. When completed they measured 6,000 feet in length, each link weighed 165 lbs., the completed cables weighing nearly half a million pounds. In testing these chains in the testing department of the Lebanon Works, they withstood a strain of 549,500 lbs., without fracturing a link or starting a weld, but breaking the jaw and feed of the testing machine in making the test. This test exceeded the requirements by 55,020 lbs., or over 27½ per cent as the Lloyds Register of England only requires a breaking strain of 494,480 lbs.

The order for these immense chains suggested to Mr. Attwood the fact that greater results could be brought about by increasing his facilities and he began the construction of his immense new plant that now operates over 200 fires. The company no longer confine their efforts to ship cables and high grade hand made chains only, for they are fully equipped to manufacture machine made chains of all grades and descriptions as well. In the past, this company has been awarded the majority of the government contracts that are placed through the department of commerce and labor, by the lighthouse department and used for anchor cables on the light ships. Up to the present time they have furnished the navy department with all the ship cables required for battleships and cruisers, with the exception of those made by the department themselves, at the government chain shop, located in the Charleston navy yard, Boston, Mass.

This class of chain is subjected to particularly rigid and exacting tests and inspections under the supervision of government officials. The severe strains and adverse conditions they are subjected to necessitates their being made of specially rolled stock, which the government submits to exhaustive laboratory analyses and physical tests.

Being appointed licensed testers of government cables and also for the Lloyd's Association, American Bureau of Shipping and Bureau of Veritas, they have installed in their testing department a testing machine of 600,000 lbs. capacity; the largest in use for chain testing purposes.

The Lebanon Chain Works having been awarded all of the contracts for ship cables that the government required for our battleships and cruisers, as well as the majority of the contracts placed through the department of commerce and labor for the lighthouse department, competition caused to have circulated rumors derogatory to their reputation as manufacturers. These rumors caused the department to make an investigation resulting in the assistant secretary of the United States navy issuing a letter dated Washington, Jan. 18 to the Lebanon Chain Works, completely vindicating them and stamping the reports referred to as groundless.

The New York offices of the Lebanon Chain Works & Iron Co., of which Mr. Eli Attwood is also president, are located in the Battery Park building, 21 to 24 State street, in charge of Mr. W. J. Barstow, who is vice president and sales manager of that company. Mr. Barstow has had wide experience in the different lines that the Lebanon Chain Works with their increased facilities manufacture. The new company will market the product of the Lebanon Works, who will in future incorporate the feature of long lapped self-locking welds in all their high grade chains, as an officer in the New York company is a part owner of the patent (pending) covering the machinery necessary to make the genuine self-locking weld.

In order to comply with the demands and adverse conditions that wire hoisting cables are subjected to when operated on dredges and steam shovels, the company has completed arrangements for the manufacture of a special wire cable which is made from wires drawn in England especially for the purposes the rope is intended to be used for. This wire rope is so constructed that the wearing surface is made of larger wires than the rest of the cable, giving it great friction restricting qualities; the inside wires being smaller, equalizes the strains and causes the cable to be particularly flexible. This hoisting cable combining great tensile strength with friction resisting qualities and flexibility is filling a long felt want among operators of dredges and steam shovels who use wire rope on their machines. The cable is marketed under the company's copyright brand and trade mark.

The Lebanon company also manufacture spikes (ship, dock and railroad), and other materials in demand by ship builders, railroad and mining companies, contractors and supply houses, as well as the heavy hardware trade.

MEAN STAGES OF WATER.

The gauge records of the United States lake survey show the following means stages of water above mean sea level, for April, 1906:

	Stages during April. Feet.	Higher than during same month last year. Feet.	Lower than during same month last year. Feet.	Higher than during April, 1895. Feet.	Lower than during April, 1895. Feet.
Lake Superior	602.19		0.06	0.18	
Lake Michigan	581.00	0.28		1.03	
Lake Huron	580.97	0.31		1.02	
Lake Erie	572.10	0.27		0.84	
Lake Ontario	246.35	0.25		1.61	

Present fall Lake Huron to Lake Erie, 0.04 foot more than a year ago.

The department of docks and ferries of New York has received the following bids for repairing the municipal ferry boats Robert Garrett and Castleton: John T. Walsh Jr., 136 Charlton street, New York, $180,500; James Reilly Repair & Supply Co., 78 Beach street, New York, $175,000; James Shervan & Son, Houston street and East river, $149,000; J. Edward Ogden Co., 147 Cedar street, $161,000; Alexander Miller Bros., 10 Morris street, Jersey City, N. J., $175,750; Columbia Engineering Works, Imlay street, Brooklyn, $183,000.

WANTED and FOR SALE Department.

PROPOSALS.

Treasury Department, Office of General Superintendent U. S. Life-Saving Service, Washington, D. C., April 30, 1906. Sealed proposals will be received at this office until 2 o'clock p. m. of Wednesday, the 23d day of May, 1906, and then publicly opened, for furnishing supplies required for use of the Life-Saving Service for the fiscal year ending June 30, 1907; the supplies to be delivered at such points in New York City, Grand Haven, Mich., and San Francisco, Cal., as may be required, and in the quantities named in the specifications. The supplies needed consist of Beds, Bedding, and Furniture; Brooms and Brushes; Crockery; Hardware; Household Goods; Lamps, Lanterns, etc.; Medicines, etc., Paints, Oils, etc.; Ship Chandlery; Stoves, etc.; Tools, and Miscellaneous Articles; all of which are enumerated in the specifications attached to the form of bid, etc., which may be obtained upon application to this office, or to the Inspector of Life-Saving Stations, 379 Washington Street, New York City; Superintendent Twelfth Life Saving District, Grand Haven, Mich.; and Superintendent Thirteenth Life-Saving District, New Appraisers' Stores, San Francisco Cal. Envelopes containing proposals should be addressed to the "General Superintendent U. S. Life-Saving Service, Washington, D. C.," and marked on the outside "Proposals for Annual Supplies." The right is reserved to reject any or all bids, and to waive defects, if deemed for the interests of the Government. S. I. KIMBALL,
General Superintendent.

U. S. Engineer Office, Buffalo, N. Y., April 20, 1906.—Sealed proposals in triplicate for construction of stone breakwater at South Harbor Entrance, Buffalo, N Y., will be received here until 11 A. M. May 21, 1906, and then opened. Information furnished on application. H. M. ADAMS, Col. Engrs.

U. S. Engineer Office, Jones Building, Detroit, Mich., April 14, 1906. Sealed proposals for dredging Round Island Shoals, St. Marys River, Mich., will be received at this office until 2 p. m. May 14, 1906, and then publicly opened. Information furnished on application. CHAS E. L. B. DAVIS, Col., Engrs.

FOR SALE.

For Sale.

Two Barges, Andrew Walton and Little Jake. Very cheap. Also two stationary Boilers, Engines and Pumps. For particulars call or write

JOHN HOLWAY,
Put-in-Bay, O.

Steamer Hazel.

For sale at Grand Haven, Michigan, the passenger and freight steamer "Hazel." Length 93 ft, beam 18 ft, draft about 7′ 6″. For further particulars address

MRS. R. B. RICE,
157 4th st., Muskegon, Mich.

A Bargain.

Steamer E. F. Gould, length 137 ft., width 28 ft, depth 8 ft. 5 in, tonnage 261 tons. Boiler, engine and hull in good condition. First-class, complete sand pumping outfit now installed on boat, will sell with boat if so desired. Apply

JOHN M. McKERCHEY,
Detroit, Mich.

For Sale.

Five Scotch Boilers, allowed 160 lbs. steam. Good as new. ERIE MACHINERY CO., 729 Garfield Bldg., Cleveland, O.

FOR SALE.

For Sale.

1,000 h. p. fore and aft Neafie & Levy compound Engine; surface condenser; independent pumps.
Two 12 foot Scotch Boilers.
One 13½ foot Scotch Boiler.
One 10 16-25 x 16 triple expansion Engine.
Three 50 h. p. Almy Boilers.
One 200 h. p. Tregurtha Boiler.
One 14 30 x 24 fore and aft Engine and condenser.
One Williamson steering Engine.
One 10 k. w. electric lighting Set.
One 15 k. w. electric lighting Set.
One Providence Windlass, 50 fathoms 1½ in. chain.
Two thrust Shafts and Bearings, 8½ in. diameter.

MARVIN BRIGGS,
17 Battery place, New York, N. Y.

WANTED

Engines

WANTED: Fore and Aft Compound Engine not less than 20″ x 40″ x 30 One Double High Pressure Engine not less than 20″ x 24″. Address 583 14th Ave, Detroit, Mich.

Buyers' Directory of the Marine Trade

For a more complete classification than that represented by advertisers in the Marine Review, see the BLUE BOOK OF AMERICAN SHIPPING, marine and naval directory of the United States, published by The Marine Review, Cleveland.

See accompanying index of Advertisers for full addresses of concerns in this directory.

AIR COMPRESSORS, AIR HOISTS, ETC.
Great Lakes Engineering Works......Detroit.

AIR PORTS, DEAD LIGHTS, ETC.
Marine Mfg. & Supply Co.........New York.

AIR PUMPS AND APPLIANCES.
Fore River Ship & Engine Co..Quincy, Mass.
Great Lakes Engineering Works......Detroit.

ANCHORS.
Bowers, L. M. & Co......Binghamton, N. Y.

ANTI-FRICTION METALS.
Cramp, Wm. & Sons...........Philadelphia.

ARTIFICIAL DRAFT FOR BOILERS.
American Ship Building Co.........Cleveland.
Detroit Ship Building Co.............Detroit
Great Lakes Engineering Works......Detroit

ASH EJECTORS.
Great Lakes Engineering Works......Detroit.

ATTORNEYS AND PROCTORS IN ADMIRALTY.
Gilchrist, Albert J................Cleveland.
Goulder, Holding & Masten........Cleveland.
Hoyt, Dustin & Kelley............Cleveland.
Jenkins, Russell & Eichelberger....Cleveland.
Kremer, C. E.......................Chicago.
MacDonald, Ray G...................Chicago.
Shaw, Warren, Cady & Oakes........Detroit.
White, Johnson, McCaslin & Cannon Cleveland

BAROMETERS, MARINE GLASSES, ETC.
Ritchie, E. S. & Sons.......Brookline, Mass.

BELTING (LEATHER).
Republic Belting & Supply Co......Cleveland.

BLOCKS, SHEAVES, ETC.
Boston & Lockport Block Co.....Boston, Mass.
Cleveland Block Co................Cleveland.

BOAT BUILDERS.
Drein, Thos. & Son.........Wilmington, Del.
Kahnweiler's Sons, David.........New York.
Marine Construction & D. D. Co..........
..........Mariner's Harbor, S. I., N. Y.
Truscott Boat Mfg. Co.....St. Joseph, Mich.

BOILER COMPOUNDS.
The Bird-Archer Co.............. New York
Dearborn Drug & Chemical Works....Chicago.
State Manufacturing Co...............Cleveland.

BOILER MANUFACTURERS.
Almy Water Tube Boiler Co..Providence, R. I.
American Ship Building Co.........Cleveland.
Atlantic Works..........East Boston, Mass.
Chicago Ship Building Co...........Chicago.
Cramp, Wm. & Sons...........Philadelphia.
Dearing Water Tube Boiler Co........Detroit.
Detroit Ship Building Co............Detroit.
East End Boiler Works..............Detroit.
Fletcher, W. A. & Co.........Hoboken, N. J.
Fore River Shipbuilding Co.....Quincy, Mass.
Great Lakes Engineering Works......Detroit.
Kingsford Foundry & Machine Works....
.........................Oswego, N. Y.
Maryland Steel Co.......Sparrows Point, Md.
Milwaukee Dry Dock Co..........Milwaukee.

BOILER MANUFACTURERS—Continued.
Mosher Water Tube Boiler Co....New York.
Newport News Ship Building Co.........
......................Newport News, Va.
New York Shipbuilding Co.....Camden, N. J.
Northwestern Steam Boiler & Mfg. Co....
..........................Duluth, Minn.
Quintard Iron Works Co...........New York.
Roberts Safety Water Tube Boiler Co....
............................New York.
Superior Ship Building Co.....Superior, Wis.
Taylor Water Tube Boiler Co........Detroit.

BOILER RIVETS.
Bourne-Fuller Co.................Cleveland.

BOILER STAYBOLTS, IRON OR STEEL, HOLLOW OR SOLID.
Falls Hollow Staybolt Co..Cuyahoga Falls, O.

BRASS AND BRONZE CASTINGS.
Cramp, Wm. & Sons............Philadelphia.
Fore River Ship & Engine Co..Quincy, Mass.
Great Lakes Engineering Works......Detroit.
Lunkenheimer Co..................Cincinnati.

BRIDGES, BUILDERS OF.
Scherzer Rolling Lift Bridge Co.....Chicago.

BUCKETS, ORE AND COAL.
Brown Hoisting & Conveying Machine Co.
.... Cleveland.

CABIN AND CABINET FINISHING WOODS.
Martin-Barriss Co...................Cleveland.

CANVAS SPECIALTIES.
Baker & Co., H. H...................Buffalo.
Bunker, E. A. ....New York.
Upson-Walton Co..................Cleveland.
Republic Belting & Supply Co......Cleveland.

CAPSTANS.
American Ship Windlass Co..Providence, R. I.
Dake Engine Co.............Grand Haven, Mich.
Hyde Windlass Co..................Bath, Me.
Marine Mfg. & Supply Co.........New York.

CEMENT, IRON FOR REPAIRING LEAKS.
Smooth-On Mfg. Co.........Jersey City, N. J.

CHAIN CONVEYORS, HOISTS.
Brown Hoisting Machinery Co. (Inc.)....
.... Cleveland.
General Electric Co........Schenectady, N. Y.

CHAIN HOISTS.
Boston & Lockport Block Co....Boston, Mass.
Republic Belting & Supply Co.....Cleveland, O.

CHARTS.
Penton Publishing Co.............Cleveland.

CLOCKS (Marine and Ship's Bell) AND CHRONOMETERS.
Ritchie, E. S. & Sons........Brookline, Mass.

COAL PRODUCERS AND SHIPPERS.
Hanna, M. A. & Co...............Cleveland.
Pickands, Mather & Co............Cleveland.
Pittsburg Coal Co.................Cleveland.

COAL AND ORE HANDLING MACHINERY.
Brown Hoisting Machinery Co. (Inc.)....
.... Cleveland.

COMPASSES.
Ritchie, E. S. & Sons........Brookline, Mass.

CONDENSERS.
Great Lakes Engineering Works......Detroit.
Thropp & Sons Co., John E...Trenton, N. J.
Wheeler Condenser & Engineering Co. New York.

CONTRACTORS FOR PUBLIC WORKS.
Breymann & Bros., G. H.............Toledo.
Buffalo Dredging Co.................Buffalo.
Dunbar & Sullivan Dredging Co.....Buffalo.
Graves & Stephens.................. Cleveland.
Great Lakes Dredge & Dock Co.....Chicago.
Hickler Bros.......Sault Ste. Marie, Mich.
Hubbell Co., H. W................Saginaw.Mich.
Smith Co., L. P. & J. A............Cleveland.
Starke Dredge & Dock Co., C. H..Milwaukee.
Standard Contracting Co.............. Clevelnad
Sullivan, M..........................Detroit.

CORDAGE.
Baker & Co., H. H.................Buffalo.
Upson-Walton Co..................Cleveland.

CORK JACKETS AND RINGS.
Armstrong Cork Co............Pittsburg, Pa.
Kahnweiler's Sons, D..............New York.

CRANES, TRAVELING.
Brown Hoisting Machinery Co......Cleveland.

DIVING APPARATUS.
Morse, A. J. & Son..................Boston.
Schrader's Son, Inc., A........ ... New York.

DREDGING CONTRACTORS.
Breymann & Bros., G. H.............Toledo.
Buffalo Dredging Co................Buffalo.
Dunbar & Sullivan Dredging Co......Buffalo.
Great Lakes Dredge & Dock Co.....Chicago.
Hickler Bros..........Sault Ste. Marie, Mich.
Hubbell Co., H. W................Saginaw, Mich.
Smith Co., L. P. & J. A...........Cleveland.
Starke Dredge & Dock Co., C. H..Milwaukee.
Sullivan, M...........................Detroit.

DREDGING MACHINERY.
Quintard Iron Works Co...........New York.

DRY DOCKS.
American Ship Building Co........Cleveland.
Atlantic Works...........East Boston, Mass.
Buffalo Dry Dock Co.................Buffalo.
Chicago Ship Building Co............Chicago.
Cramp, Wm. & Sons............Philadelphia.
Detroit Ship Building Co.............Detroit.
Great Lakes Engineering Works......Detroit.
Lockwood Mfg. Co.......East Boston, Mass.
Milwaukee Dry Dock Co..........Milwaukee.
Newport News Ship Building Co.........
......................Newport News, Va.
Shipowners Dry Dock Co............Chicago.
Superior Ship Building Co....Superior, Wis.
Tietjen & Lang Dry Dock Co.....Hoboken, N.J.

DREDGE BUILDERS.
Manitowoc Dry Dock Co........Manitowoc, Wis.

DYNAMOS.
General Electric Co...........Schenectady, N. Y
Thropp & Sons, John E............Trenton, N. J.

ELECTRIC HOISTS AND CRANES.
General Electric Co........Schenectady, N. Y.

Buyers' Directory of the Marine Trade.—*Continued.*

ELECTRIC LIGHT AND POWER PLANTS.
General Electric Co.......Schenectady, N. Y.
Thropp & Sons, John E.......Trenton, N. J.

ENGINE BUILDERS, MARINE.
American Ship Building Co.........Cleveland.
Atlantic Works...........East Boston, Mass.
Chicago Ship Building Co..........Chicago.
Chase Machine Co.................Cleveland.
Cramp, Wm. & Sons............Philadelphia.
Detroit Ship Building Co............Detroit.
Fletcher, W. & A. Co.........Hoboken, N. J.
Fore River Shipbuilding Co....Quincy, Mass.
Great Lakes Engineering Works.Detroit, Mich.
Hall Bros. ....Philadelphia.
Lockwood Mfg. Co.........East Boston, Mass.
Maryland Steel Co.......Sparrows Point, Md.
Milwaukee Dry Dock Co..........Milwaukee.
Mosher, Chas. D.................New York.
Newport News Ship Building Co.........
.......................Newport News, Va.
New York Shipbuilding Co....Camden, N. J.
Northwestern Steam Boiler & Mfg. Co...
.... Duluth, Mich.
Quintard Iron Works Co..........New York.
Roach's Ship Yard..............Chester, Pa.
Sheriffs Mfg. Co.................Milwaukee.
Superior Ship Building Co....Superior, Wis.
Thropp, J. E. & Sons Co......Trenton, N. J.
Trout, H. G..........................Buffalo.

ENGINE ROOM TELEGRAPH, CALL BELLS, ETC.
Cory, Chas. & Son................New York.
Marine Mfg. Supply Co............New York.

ENGINEERING SPECIALTIES AND SUPPLIES.
Lunkenheimer Co. ....Cincinnati.
Northwestern Steam Boiler & Mfg. Co...
.... Duluth, Minn.

ENGINEERS, MARINE, MECHANICAL, CONSULTING.
Hynd, Alexander ....Cleveland.
Hunt, Robt. W. & Co.................Chicago.
Kidd, Joseph..................Duluth, Minn.
Mosher, Chas. D..................New York.
Nacey, James ....Cleveland.
Roelker, H. B. ....New York.
Wood, W. J. ....Chicago.

FEED WATER PURIFIERS AND HEATERS.
Greacen-Derby Engineering Co.............
.......................Perth Amboy, N. J.
Ross Valve Co.....................Troy, N. Y.
Wheeler Condenser & Engineering Co.New York.

FIXTURES FOR LAMPS, OIL OR ELECTRIC.
General Electric Co.......Schenectady, N. Y.

FORGES.
Sutton Co., C. E..................Toledo, O.

FORGINGS FOR CRANK, PROPELLER OR THRUST SHAFTS, ETC.
Cleveland City Forge & Iron Co...Cleveland.
Fore River Shipbuilding Co.....Quincy, Mass.
Macbeth Iron Co.................Cleveland.

FLUE WELDING.
Fix's, S. Sons.....................Cleveland.

FUELING COMPANIES AND COAL DEALERS.
Hanna, M. A. & Co..............Cleveland.
Ironville Dock & Coal Co..........Toledo, O.
Parker Bros. Co., Ltd..............Detroit.
Pickands, Mather & Co...........Cleveland.
Pittsburg Coal Co.................Cleveland.
Smith, Stanley B., & Co............Detroit.

FURNACES FOR BOILERS.
Continental Iron Works..........New York.

GAS BUOYS.
Safety Car Heating & Lighting Co..New York.

GAS AND GASOLINE ENGINES.
Chase Machine Co................Cleveland.

GAUGES, STEAM AND VACUUM.
Lunkenheimer Co. ....Cincinnati.

GAUGES, WATER.
Lunkenheimer Co. ....Cincinnati, O.

GENERATING SETS.
General Electric Co...........Schenectady, N. Y.

GRAPHITE.
Dixon Crucible Co., Joseph..Jersey City, N. J

GREASE EXTRACTORS.
Greacen-Derby Engineering Co.............
........................Perth Amboy, N. J.

HAMMERS, STEAM.
Chase Machine Co.................Cleveland.

HEATING APPARATUS.
Sutton Co., C. E..................Toledo, O.

HOISTS FOR CARGO, ETC.
American Ship Building Co........Cleveland.
Brown Hoisting Machinery Co. (Inc.)....
.... Cleveland.
Chase Machine Co................Cleveland.
Dake Engine Co........... Grand Haven, Mich.
General Electric Co...............New York.
Georgian Bay Engineering Works........
..........................Midland, Ont.
Hyde Windlass Co.................Bath, Me.
Marine Iron Co....................Bay City.

HOLLOW SHAFTINGS, IRON OR STEEL.
Falls Hollow Staybolt Co...Cuyahoga Falls, O.

HOLLOW STAYBOLT IRON.
Falls Hollow Staybolt Co...Cuyahoga Falls, O.

HYDRAULIC DREDGES.
Great Lakes Engineering Works......Detroit.

HYDRAULIC TOOLS.
Watson-Stillman Co., The.........New York.

ICE MACHINERY.
Great Lakes Engineering Works......Detroit.
Roelker, H. B..................New York.

INJECTORS.
American Injector Co................Detroit.
Jenkins Bros. ....New York.
Lunkenheimer Co.................Cincinnati.
Penberthy Injector Co.........Detroit, Mich.

INSURANCE, MARINE.
Elphicke, C. W. & Co..............Chicago.
Fleming & Co., E. J...............Chicago.
Gilchrist & Co., C. P.............Cleveland.
Hawgood & Co., W. A.............Cleveland.
Helm & Co., D. T...................Duluth.
Hutchinson & Co..................Cleveland.
McCarthy, T. R..................Montreal.
McCurdy, Geo. L....................Chicago.
Mitchell & Co....................Cleveland.
Parker Bros. Co., Ltd..............Detroit.
Peck, Chas. E. & W. F..New York & Chicago.
Prindiville & Co....................Chicago.
Richardson, W. C................Cleveland.
Sullivan, D. & Co.................Chicago.

IRON CASTINGS.
Sutton Co., C. E..................Toledo, O.

IRON ORE AND PIG IRON.
Bourne-Fuller Co.............Cleveland, O.
Hanna, M. A. & Co...............Cleveland.
Pickands, Mather & Co............Cleveland.

LAUNCHES—STEAM, NAPHTHA, ELECTRIC.
Truscott Boat Mfg. Co.....St. Joseph, Mich.

LIFE PRESERVERS, LIFE BOATS, BUOYS.
Armstrong, Cork Co...............Pittsburg.
Carley Life Float Co............New York, N. Y.
Drein, Thos. & Son.........Wilmington, Del.
Kahnweiler's Sons, D.............New York.

LIGHTS, SIDE AND SIGNAL.
Russell & Watson ....Buffalo.

LOGS.
Nicholson Ship Log Co............Cleveland.
Walker & Sons, Thomas....Birmingham, Eng.
Also Ship Chandlers.

LUBRICATING GRAPHITE.
Dixon Crucible Co., Joseph..Jersey City, N. J.

LUBRICATORS.
Lunkenheimer Co. ....Cincinnati

LUMBER.
Martin-Barriss Co..................Cleveland.

MACHINISTS.
Chase Machine Co.................Cleveland.
Hickler Bros.........Sault Ste. Marie, Mich.
Lockwood Mfg. Co........East Boston, Mass.

MACHINE TOOLS (WOOD WORKING).
Atlantic Works, Inc.............Philadelphia.

MARINE RAILWAYS.
Hickler Bros..........Sault Ste. Marie, Mich.

MARINE RAILWAYS, BUILDERS OF.
Crandall & Son, H. I.....East Boston, Mass.

MATTRESSES, CUSHIONS, BEDDING.
Fogg, M. W.....................New York.

MECHANICAL DRAFT FOR BOILERS.
American Ship Building Co........Cleveland.
Detroit Ship Building Co.............Detroit.
Great Lakes Engineering Works......Detroit.

METALLIC PACKING.
Katzenstein, L. & Co.............New York.
The National Metallic Packing Co....Oberlin, O.

MOTORS, GENERATORS—ELECTRIC
General Electric Co.......Schenectady, N. Y.

NAUTICAL INSTRUMENTS.
Benjamin Farnum How.................Boston
Ritchie, E. S., & Sons......Brookline, Mass.

NAVAL ARCHITECTS.
Hynd, Alexander ....Cleveland.
Kidd, Joseph ....Duluth, Minn.
Mosher, Chas. D..................New York.
Nacey, James ....Cleveland.
Wood, W. J. ....Chicago.

OAKUM.
Stratford, Oakum Co.......Jersey City, N. J.

OILS AND LUBRICANTS.
Dixon Crucible Co., Joseph..Jersey City, N. J.

PACKING.
Jenkins Bros. ....New York.
Katzenstein, L. & Co.............New York.
The National Metallic Packing Co....Oberlin, O.
Republic Belting & Supply Co.....Cleveland, O.

PAINTS.
Baker, Howard H. & Co.............Buffalo.
Upson-Walton Co. ....Cleveland.

PATTERN SHOP MACHINERY.
Atlantic Works, Inc............Philadelphia.